THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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ON GOING ABROAD.

IN these days when there is far more electrical engineering work in progress and prospect abroad than there used to be, and when for this and other reasons there is a willingness, nay, an eagerness, on the part of so many young electrical engineers to leave the Mother Country, our inquiry box contains many interesting questions from those who want to know whether we would advise them to go to this country or to that rather than to remain at home. We are asked to furnish them with names of individuals or companies with whom they ought to correspond in order to "get a job," sometimes we are asked to advise as to climate, cost of living, and on the question of agreements between parties entering into engagements. Quite a large number of men have availed themselves of the information that we have in the course of years been enabled to bring together or to publish in our pages, and scores of them now stationed thousands of miles away from home in very different surroundings from those prevailing here, will be reading these lines and recalling the occasion upon which they sought our humble counsel. It has always been a pleasure to us to assist in every way in our power those who felt a disposition to remove to a less crowded sphere of operations, but we have endeavoured to make it plain that our information was intended to guide them in forming their own conclusions. It would be unwise for us to say either "Go!" or "Don't go!"

Our duty and responsibilities are at an end when we have placed before our correspondents facts and reports received from men of experience or obtained from records upon which reliance can usually be placed. But where one man may have seen signs of satisfactory openings, and may have actually succeeded, another may in experience not do so well. Further, information relating to one part of a country may not have an accurate application in respect to another part a hundred miles away. What may be healthy and congenial climate and surroundings for one man may not be so for another. An agreement in certain terms may have met the case between two parties under certain circumstances, but may prove totally unsatisfactory for other parties and different circumstances. One man may be able to manage admirably and save money on a specified income, while another, because of extravagant tastes and dispositions, may be on the verge of poverty half the time. The mere mention of these few considerations will illustrate how difficult it is to give guidance which shall in every case prove, in matters of detail, to be perfectly accurate. All we can pretend to do is to satisfy the thirst for information by advising in broad terms, giving recorded facts, and publishing letters and articles from men of experience in the countries in which our readers are interested.

An aside here may be pardoned. As in connection with many other phases of electrical work, we are surprised to find how little the rank and file in the profession and industry seem to make use of electrical

directories. These are to be found in thousands of offices in the kingdom, and it ought not to be difficult to gain access to them. The man who contemplates going abroad and does not know where to go or to whom to write would, we should have thought, regard such a publication not only as one of the essentials for study before going, but one to be put away in his trunk when he leaves, for many men abroad change from one place to another and find it more difficult to secure directory information there than they need do at home. Scores of times we have been asked for information respecting colonial and foreign cities and firms that could have been obtained with facility from published volumes. Just the same thing continues to obtain in regard to the voltages, and so forth, respecting electrical systems abroad, and names of makers of specialised electrical articles, and such information is frequently sought by firms who have no need to be asking for something for nothing. We do not say this as a protest—we continue to answer questions with as good a grace as may be, knowing from experience how strange and wonderful are the claims made upon an editor's time, especially since the telephone became so essential a weapon in connection with industry, and we are glad to render reasonable assistance when it lies within our power, but when publications are specially prepared to meet particular requirements, a wider use of them might be desirable.

But, returning after this digression to the subject of electrical situations abroad, we would say that the advice that is given in our pages regarding different countries is tendered by men who know what they are talking about, *because they have been through the mill.* It would be folly for any reader to imagine that in his own case he was going to reproduce all the characteristics and circumstances that have made up the experience of the expert observer who goes to the trouble of giving us all the benefit of his advice. If he have a grain of common sense, he will know that such writers do not communicate their views for the fun of the thing. A correspondent who writes criticising some recent remarks of our Canadian contributor does so in a spirit that we are not inclined to encourage in our "Correspondence" columns. We wonder whether he will be impressed with the sincerity of our representative if we tell him that he is a Britisher who has had many years of practical electrical experience in this country learning the conditions here, followed by several years in electrical service in Canada, part of the time roughing it and observing from close quarters the conditions relating to electrical employment there. When he selected an advertisement from a Canadian paper for a text it was with a sincere intention to save young electrical men, who knew little of Canada, from making a mistake. Articles of this character are hardly intended for the education of those who pride themselves upon the possession of a more complete knowledge and a higher intelligence.

Electrical Engineers in India.

It is very satisfactory to learn from several authorities that the electrical industry in India is, generally speaking, in a very flourishing condition just now. In the annual review of the trade of India for the year ending March 30th last, the Director-General of Commercial Intelligence says there has been a falling-off in the imports of machinery of all kinds except electrical. Electrical machinery, with its total of £266,700, reached its best figure on record, while electrical instruments and apparatus were imported to the value of £440,128, as compared with £343,382 in 1910-11. From an authority of lengthy experience in the country we learn that, notwithstanding that competition is far keener than it used to be, and prices consequently are ruling lower for contracts large and small, and although there are far more local electrical firms doing business, and many more home manufacturers' representatives on the spot than formerly, still, everyone seems busy and fairly full of orders. Judging by the advertising columns of the newspapers in Bombay, Madras, Calcutta and other large centres, the supply of electrical engineers is not equal to the demand, and owners and managers of contracting firms are finding it hard to get the right man locally. Lest these remarks should be an encouragement to some of the more enterprising and adventurous youths of the electrical profession at home to wander out to India on the offchance of a good berth, let it be said here that this is not an advisable thing to do. A raw youth from home is not of very much service to a firm until after, say, a probationary period of 12 months, during which time he is getting accustomed to the ways of things and acquiring a smattering of the language.

Again, we understand that a pure European from home is very often looked upon as an adventurer of sorts if he is not covenanted out in the orthodox way, that is, sent out either with or without an agreement by the home head office of firms trading in India. "The best method of procedure, therefore, for anyone wanting to come out is," says our correspondent, "to watch the advertisements in the home leading electrical weeklies." A man to have hopes of being a successful applicant must, first of all, be physically sound; secondly, he ought to have had a good general engineering training, both mechanical and electrical; a knowledge and experience of isolated plants, house wiring and estimating, is of far more use to the average contractor's engineer in India than, say, a knowledge of central station work. A man should be resourceful, so as to be equal to emergencies when carrying out work far away from help; he should have unlimited patience to enable him philosophically to endure the petty vexations, the sometimes crass stupidity, of the native workman or coolie; and he should have a fund of tact and diplomacy, so as to help him to keep friendly, and, in fact, become popular with the subtle native with whom he probably will come into close touch. A golden rule for a young and, indeed, any class or age of engineer is to treat an Indian customer as a gentleman, whether or not he is one; and to treat an Indian workman with justice and firmness. Both the former and the latter soon recognise the qualities of a sahib and treat him accordingly.

A good deal might be written about the pay and prospects and life generally of electrical men in India; enough for the present, however, to say that a man going out under covenant "should not agree to accept less than 300 rupees a month as a minimum, with an annual increment of 50 rupees per month; if he accepts less than this, he is either too young to leave home or too modest as to his deserts. In addition to this, he should bargain for a trip home for six months every four years either on full pay, he to pay his own passage money, or half-pay with free passage home and back provided. To a man earning, say, £2 or £3 a week at home, £20 a month (which is the equivalent of 300 rupees), may seem a thumping big sum, but he will want every pice of it. Ordinary living, clothes, and little luxuries are far more costly in India than in England."

As our readers may have imagined, the life of an engineer in India will be brimful of interest and experience, and it is said that nowhere under the sun can a man with imagination and a love of the picturesque enjoy life with such keenness, even despite the sometimes adverse conditions of health and climate.

An Important Case as to the Measure of Damages.

It is not often that reports of engineering cases appear in the records of legal proceedings. They are generally settled by arbitration or before some tribunal whose decisions are not recorded in print. The "Law Reports" for October, however, contain a note of a case which involved a very important principle in relation to the measure of damages where machinery, as delivered, fails to come up to specification.

The case in question is the now famous one in which the British Westinghouse Electric and Manufacturing Co. sought to recover from the Underground Electric Railway of London for certain turbines which failed to satisfy the conditions of the contract as to economy of working. The railway company accepted the machines, reserving their right to damages for the breach of contract, and subsequently, in order to avoid the expense of the continued use of the machines, bought Parsons turbines to replace them. It appeared that if the railway company had continued to use the Westinghouse machines, the loss which they would have suffered in consequence of the breach of contract would have represented a larger sum than the price paid for the substituted Parsons machines. Their loss would have been the amount by which the cost of working the machines supplied, during a period of years representing the normal life of a Westinghouse machine, would have exceeded the cost of working Westinghouse machines constructed in accordance with the contract for the same period.

An arbitrator found that the railway company were entitled to recover, as damages, the costs of providing the Parsons machines. The Court of Appeal held that he was fully justified in arriving at such a decision, although the Parsons machines were so superior to the others that it would have been to the pecuniary advantage of the railway company to have effected the substitution at their own cost, even if the machines had been supplied in accordance with the contract. Lord Justice Buckley stated the principle (which seems to be the embodiment of common sense) very clearly, when he said: "If a man who has taken a third-class ticket from London to the North by one of the great companies is, by the negligence of that company, damaged by their breach of contract to convey him, and he, to reduce the damages, goes to another of the great companies, and takes a ticket by the next train on that line, and is thus enabled to reach his destination by the contract time, but cannot travel by that train unless he takes a first-class ticket, his damages may well be the whole of the sum he has to pay for that ticket, although the result is that he has enjoyed a greater luxury of travel."

This decision may be summarised by saying that the purchasers of a machine which is not capable of doing the work required of it will take note that they are entitled to replace it by another and recover the cost from the purchaser. It is the duty of a disappointed purchaser to reduce his damage as much as possible, and this is but one method of doing it.

Industrial Banks.

The subject of industrial banks for the assistance and furtherance of industrial enterprise, or sectional electrical banks or other analogous institutions for the electrical industry, has been discussed at great length again and again, and it may be that one reason why we hear less about it at the moment is found in the general trade prosperity in which the electrical industry is sharing. But it will assuredly come forward again in course of time, when the position becomes less rosy again, and when Continental electrical firms score new successes by the same means. The functions and practice of our ordinary banks do not seem to be conducive to industrial business in the form that some critics would desire to see, and it may well be doubted whether banks, as we know them, afford any material support to industrial enterprise, but, as has been said before, much of the business that would be done by industrial banks, were they in vogue, has been and is being done by financial houses and certain quasi-investment undertakings. We have, however, witnessed on notorious occasions the loss of important foreign transactions and works by this country, because of the greater readiness of foreign banks, having competent electrical advisers, to snatch them up.

There would appear to be scope for an electrical bank or some similar undertaking, formed and conducted upon proper lines; but it is a *sine quâ non* that it should be absolutely free and independent in its formation and government. A, B and C are, say, directors of such an institution, and they are also connected, say, as directors or in the management of certain electrical undertakings; D, E and F, who are not directors, but who are similarly interested in electrical enterprise, and require certain objects financing, would hesitate to approach the bank or institution in which A, B and C figured, to whom they would be required to impart much of the inner history or objects of the enterprise in view. And rightly so.

Plant Extensions at Leeds.

An interesting report bearing on the future of electricity supply in Leeds, with accompanying curves and plans, has been presented by Mr. Dickinson, of the electricity department, to his Committee, and is summarised elsewhere in this issue.

Incidentally, it emphasises the fact that here, as elsewhere in both Lancashire and Yorkshire, the price of electrical energy is reaching a sufficiently low level to attract the attention of the textile and allied trades, and that in consequence the latter are becoming more generally appreciative of the possibilities of electrical driving.

Mr. Dickinson makes a comprehensive survey of the prospects of the area in "10 to 15 years'" time, and he evidently anticipates a rosy future for his department, as he bases the motor-load at that date on the total usage of power in the city at present, viz., 115,000 H.P., allowing 1 KW. then for every 3½ H.P. installed now.

But if this forecast is rather on the high side—and it would be something new in electricity supply work if it were—his estimates of lighting and heating and cooking are on a most modest scale. The estimated lighting load at Christmas, 1911, after 11 years' working, was about 5,700 KW., and, he says, "this should be doubled within the next 10 to 15 years"; further, that "electric heating and cooking is now making rapid progress, and it is reasonable to assume that the maximum load in 10 to 15 years may be increased, say, by 2,500 KW."

We trust that events will prove Mr. Dickinson to have made a most conservative estimate, otherwise those engaged in the electric lighting and cooking business will be reaping the reward which attaches to a nearly stationary industry.

But to sum up: With the above loads plus 5,000 KW. for auxiliary machinery at the power station, and 6,000 KW., which it is assumed will be transferred from the tramways station on the score of price, Mr. Dickinson arrives at a total of 57,900 KW., which the Corporation may be called on to provide in the next 10 to 15 years, excluding possibilities in the matter of railway electrification, extension of the city boundaries, and normal growth of local industry.

In order, however, not to appear too optimistic, he assumes a load of only 40,000 KW., and having shown that the Whitehall Road stations will accommodate 30,440 KW. of plant, capable of taking a load of 20,000 KW., he proceeds throughout the remainder of the report to prove that the restrictions of this site in the centre of the city render it unsuitable for the operation of the large plant proposed. We quite agree with him; the absence of railway communication and coal storage alone, irrespective of other argument, seems to settle the matter, but then Mr. Dickinson has to deal with a municipal council. In each case the estimates apparently allow for some 30 per cent. of spare plant, although why this very liberal allowance should be necessary is not at all clear.

With load curves leaping upwards, it is obvious that supply problems must be tackled by big units in order to reduce standing charges to the utmost, and we trust that Mr. Dickinson will look as far ahead in this direction as he has done with regard to the future prospects of electricity supply in his area.

D

IS AMERICA GOING TO LEAD IN THE ELECTRICAL PROPULSION OF SHIPS?

[COMMUNICATED.]

No fair-minded critic can accuse the British Admiralty of any backwardness in the adoption of new ideas in naval construction. Most of the experiments which they make, although sometimes regarded askance by the critics, usually vindicate the Admiralty as represented by their engineers; and Britain continues at present to lead the rest of the world in all departments of the construction game, hull, engines, armament, and so on.

For the sake of the national pride in the maintenance of this splendidly high standard, it is to be hoped that the British Admiralty is closely watching the work which has been done in America on the electrical propulsion of ships in order that, in the event of the complete success of the American experiment now being made on the *Jupiter* (a success which is almost inevitable), they may themselves be ready to get right to work on the equipping of British war vessels with electrical machinery for the main drive. The Admiralty cannot be blamed for their policy of secrecy in regard to their attitude towards experimental schemes; and without knowing more of what constitutes their attitude in the present instance, it would certainly be absurd to censure them for not having already given some practical encouragement to the advocates of electric ship propulsion. One remembers with some feeling of uneasiness, however, that, in the naval game, a lead snatched early in the race is usually a lead which can be fairly comfortably held; and it looks at present as though the United States, by the end of next year, will have acquired a useful lead.

Englishmen interested in naval engineering matters are probably familiar with the particulars, as all the matter on the *Jupiter* equipment which has been published in American engineering papers has since been reprinted in the columns of the English technical Press. The *Jupiter* is a Government collier of about 20,000 tons, and is designed to operate at 14 knots. The generating unit consists of a six-stage Curtis turbine connected to a bipolar alternating-current generator, the speed at 14 knots being about 2,000 R.P.M., and the voltage about 2,200. The generator delivers current to two motors, each of 36 poles, and rated at 2,750 H.P. at a speed of 110 R.P.M. The ratio of synchronous speed reduction between generator and motors is 18 to 1, the propeller turning 110 R.P.M. at 14 knots. A water-cooled resistance is supplied for each motor, and is connected in series with the rotor circuit during the process of reversing and also when manœuvring the boat. There are two distinct positions of the control equipment for operating the ship—the manœuvring position, and the running position in which the motors are run with the resistance all cut out of circuit. The speed of the motors is changed by variation in the speed of the generating unit, the ratio remaining fixed at approximately 18 to 1. The change of generator speed, however, is not achieved by throttling as usual, but is obtained through the medium of a special governor with which the turbine is equipped, and which is so arranged that it is capable of automatically holding the speed at any point from about five knots up to the maximum.

The electrical equipment was thoroughly tested out at the Schenectady factory during the last summer, and came through its guarantee trials very successfully. The vessel itself was launched on the Pacific coast in August last, but will not be ready for sea until probably the middle of next summer. Without delay she will enter on her sea trials, and if the propelling equipment fails to meet its guarantee under service conditions, the Government has the option of returning the complete outfit to the manufacturer. No one who is in the least familiar with the conditions imagines that there is the slightest chance of this occurring; and we may regard it as reasonably certain that, by the fall of 1913, this electrically-driven vessel of 20,000 tons will have thoroughly indicated the wisdom of the United States naval authorities in deciding to give at least a practical trial to the arguments of the theorists, in a vessel of any considerable size. Further results will be that a foreign Government will have acquired experience in the new field (they can use the *Jupiter* for whatever test purposes they may desire, in undertaking further and bigger work along this line); and that it will be foreign electrical engineers, and a foreign factory, that will have acquired a valuable education in electrical marine engineering—an education which will be the source of the greatest encouragement and confidence for them in the tackling of the bigger problems which will follow. It is quite safe to say that they will follow. The electric propulsion proposals apply well to the *Jupiter*; they apply with far greater force to a two-speed battleship, and most electrical engineers who have studied the matter at all are convinced that the ultimate adoption of this method of propulsion for the battleships of all the great naval powers is simply a matter of time. Their reasons for so thinking are simple and direct; but the argument has not been set out so clearly, nor ventilated so widely, as one would have thought its importance has warranted; and it may be of value if the line of reasoning is here vindicated in as brief space as possible.

Steam is the source of energy used in the engines of the vessel (Diesel engines, for the moment, not being considered). The most efficient steam engine is the steam turbine. The most efficient steam turbine is the high-speed turbine. The most efficient propeller, for vessels the size of the modern battleship, is a low-speed propeller. To obtain maximum efficiency of the propelling machinery these two elements must be preserved—the high-speed turbine and the low-speed propeller. Any compromise between the ideal speeds of either results in a loss of efficiency. The turbines and propeller may be direct-connected (as in the case of the *Mauretania* with a propeller speed of 196 R.P.M.—much too low for the turbine, and too high for the propeller). It is preferable to interpose gearing, in order that the ideal speeds of the two elements be preserved. Shall this be mechanical? It is a matter of great doubt whether mechanical helical gears can be built which will carry the load required and will give the reduction which is necessary, or rather the reduction which it is actually highly desirable to obtain. The electrical gearing is entirely suitable on all grounds. The conditions present the electrical engineer with no intricate problems, no problems, in fact, which he has not already solved scores of times on land. Three-phase generators may be connected to the turbines, and be made to run at their most efficient speed, whatever that may happen to be. Cables are carried from the generators to three-phase slip-ring induction motors, which run at some low speed, within a very small percentage of the revolutions specified by the propeller requirements, whatever they may be. If the ship is to be a constant-speed vessel, as in the case of the *Jupiter*, which in steaming will nearly always require a speed somewhere around 14 knots, the speed control (what little is required) may be obtained by control of the speed of the motor, or at the throttle of the turbine. This briefly is the main argument for vessels of this class, although there are other points of importance which have been intentionally omitted (such as the doing away with cumbersome and costly reversing engines, when the necessary reversal can be achieved by a simple change over of the motor connections). And it is to this argument that the American Government authorities have yielded in proceeding with the *Jupiter*. The argument, we believe, will be vindicated, and the results in every way satisfactory.

But if the electrical system is successful in the case of a one-speed vessel like the *Jupiter*, it is easy to see that it would be vastly more suitable for two-speed battleships. A *Dreadnought* may be said to have a speed of 23 knots. In practice this level is hardly ever touched; and, except on occasional full-speed trials, the engines are never worked for this condition, but are run for the manœuvring speed of 14 or 15 knots. What, then, is the result? A daily violation of all the laws of economical steam consumption. The turbines (assuming the ship is provided with turbines) are designed to give a high efficiency around the full speed of 23 knots. For virtually the whole of their working life they will be run to give a speed of, say, 14 or 15 knots. Under the first condition they may have a consumption around, say, 11 or 12 lb. per H.P.-hour. For the low-speed condition their consumption is bound to be as high as 18 or 20 lb. per H.P.-hour. This awful waste is prevented by the inter-

position of electrical gearing. Whatever may be the speed of the vessel as required by the exigencies of the moment, warfare or peace trials, full speed or manœuvring speed, the turbines may be run at constant speed, and the necessary change in speed effected by a simple change-over switch in the motor-circuit, by means of which the number of poles may be changed from, say, 50 to 30, and the propeller speed, of course, in the same ratio. There is nothing new about the change-speed induction motor; and a clever designer could ring the changes on the turbines and motors to obtain a number of efficient combinations. The thoughtful reader may work out some of these for himself. They have all been proposed and discussed, and details of the different arrangements may be found in text-books and in various papers which have been presented before engineering societies during the last 10 years. The turbines would be run as much as possible at constant speed, or whatever speed gave the most efficient consumption for the particular loads. At half-load, full-speed, the consumption would never be very bad; while, at speeds between full speed and manœuvring speed, throttling the turbine (supposing this method of control were employed) would never approach the condition which is reached when, as is now necessary, the turbines are run throttled down to manœuvring speed through practically the whole of their working life.

The American engineers who handled the *Jupiter* are fully prepared for the battleship proposition to come along. They have been advocating electric propulsion for battleships, and have worked out scores of designs to prove the strength of their arguments. Up to the present nearly all that has actually been accomplished in ship propulsion has been their work, and in the end they will get the battleship business. The equipment of the *Jupiter* was joyfully undertaken, not because that vessel represented an ideal case for the electrical system, but because it was a chance at least of showing what the system would accomplish in the case of a large ship. The engineers regard this as the thin edge of the wedge, the thicker part being reached with the application of the electrical system to liners, cruisers and battleships. Meanwhile it must be disheartening for those English engineers who have been hoeing their own lonely row in this same field, with equal care and diligence. The time for the experiment is ripe now; but, even if it were not, one could almost believe that it would be sound policy for the British Government to place a contract with some firm of British engineers for the electrification of a new *Dreadnought*. The advocates of the electrical system in England have shown resource and ingenuity. They must also exhibit great perseverance. One of these engineers was in close touch with the Admiralty on a *Dreadnought* proposition *as long ago as* 1906; and he is still waiting for a practical try-out. I have not the pleasure of his acquaintance, and may not disclose his name, but I know that he came within a very short distance of definite business. It must, indeed, require a great pluck to continue his labours, with the fruits of successful achievement still withheld from him. He and one or two other of the English set are no whit inferior to their American rivals; but they are deserving of greater official support in that they are acting more in the capacity of private individuals than the Americans, and have not behind them the resources of a great and powerful industrial organisation. Their efforts in the past have, therefore, been all the more meritorious on that account. Let us hope that the Admiralty at home are simply holding their hand, with a watchful eye on the moves of their competitors. The electrical industry in Britain is apparently improving, but is still far from what it should be. The acquisition of some of this marine business might result in a big boom for the home manufacturers, and a well-deserved reward to those few engineers who have been pleading their cause, with such skill, perseverance and pluck, but with no tangible recognition for so many years.

Correspondence Stolen. — The British Central Electrical Co., of 84, Hatton Garden, London, E.C., desire it to be known that their letter-box was broken into on 11th inst., and correspondence stolen. They would accordingly be glad if firms who communicated with them on the 10th inst., and have not received a reply, would kindly send them copies of such communications.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Use of Mica in the Insulation of Electrical Apparatus.

Having had considerable experience in the manufacture of mica and micanite insulation, I should like to say a word on this interesting subject.

As regards the relative advantages and disadvantages of the two methods of using mica as an insulator—in spite of Messrs. Wiggins's claim for pure mica tubes, &c.—apart from commutator work, each has its own sphere of usefulness, and how often is it that one has the choice of using both? Who would think of using micanite for telegraph condensers, cooking apparatus, &c.? On the other hand, what manufacturer or workman wants to handle an insulation about five-thousandths of an inch thick alternately with mallet and wedge, for instance, and with armature coils that are not always straight until forced home, often under continuous tapping? Again, it is not advisable to use thin insulation for another reason, viz., in switchgear, where often a bush and two washers are resorted to, to insulate a live piece of metal. How would our friends the pure-mica advocates suggest forming a good insulating joint between the bush and washers, where in practice often the mica is increased to $\frac{1}{4}$ in. —not that the mica is not of sufficient resistance, but to increase the distance between the live and dead metal through the joint of the mica? Then, again, where apparatus is subject to severe dampness, and often worse, in using exceptionally thin mica, which for commercial purposes would probably not exceed 10 thousandths, is there not a possibility of moisture collecting on the edges, bridging the mica, and incidentally causing a short circuit, whereas with micanite its greater thickness would make this an impossibility, except under exceptional circumstances?

How is thin mica, as advocated by our friends, going to fare in the hands of the ordinary workman—no little consideration when he is on piece work, in which "micanite" does not always escape damage? If Messrs. Wiggins & Sons were to see how micanite gets treated sometimes, as I have done, they would soon alter their opinions somewhat, and I am afraid we mica merchants would soon have to close down for the want of raw material—no little cause for anxiety even now.

It would be interesting to know how a foot of pure mica tubing would compare with a foot of micanite ditto at the present ridiculous prices. No, I say most emphatically, pure mica will never oust micanite where price is a consideration; but the dissatisfaction with the latter material can be remedied by using better quality splittings, which means increased prices. Micanite one-sixteenth inch thick might contain splittings to the value of anything from 1d. to 1s. 6d. per lb. and the buyer not be any the wiser.

Coming back to mica again, I would say from experience that any engineer using heavily spotted mica, except for low voltages, is seeking trouble; and referring to our friends' comparison between Bengal clear and spotted mica, perhaps it is as well to mention the exceptional tendency of spotted mica to allow what is known as "creeping." I have placed the electrodes of a 2,000-volt circuit on the edges of a piece of heavily spotted mica about 4 in. wide, and the result has been a fine miniature firework display, whereas the breakdown of air would require about 40,000 volts for this distance. I think it is commonly agreed that there is no insulation resistance—above that of air—running parallel with the laminæ, the above effect being due to the almost continuous path of magnetite.

I think that if Messrs. Wiggins would inquire of their friends why they have no objection to using "hard" mica they would find that, apart from ignorance and indifference as to quality, it is either because they use it on slow-running machines or because they resort to the now common practice of undercutting the mica, *i.e.*, cutting the mica below the adjacent copper bars.

I would like to say, in conclusion, that I have made these few remarks in a perfectly unbiased manner, and speak as the result of experience, the common forms of mica

and micanite not entering largely into our manufactures. Where are our electrical engineers and buyers that they do not have anything to say on this important matter? Surely they could give us some enlightenment.

H. E. Ashdown, *Managing Director,*
The Birmingham Mica Co., Ltd.

Birmingham, *October 12th*, 1912.

Important to Exporters.

May I point out to British traders the great amount of trouble with the Customs that is liable to be caused unless material is carefully invoiced, so as to be easily classified under the various headings given in the Customs schedule of duties? For instance, rubber-insulated cable is charged on the weight (900 reis per kilo), while lead-covered cable, paper or rubber-insulated, is charged 20 per cent. duty *ad valorem*. In one case a leading firm shipped a number of motors, but instead of shipping the starters in the same packing cases, sent these separately, and thus increased the amount of duty payable by over £85. The Custom House people will seldom listen to any protest of the customer, so that too much care cannot be given to the above matter. Neglect is often the cause of goods being delayed in the Custom House for weeks, and even months.

Inglaterra.

Rio Janeiro, *September 16th*, 1912.

New Machine for Alternating Load Tests.

Regarding the interesting B.A. paper by Mr. B. P. Haigh, B.Sc., in the current issue of the Electrical Review, a description and drawing is given (fig. 2, page 531) of an alternating-current magnet for generating the stresses applied to the specimen.

Here the lines of induction pass through a yoke *viâ* a gap into an armature and again cross a central gap.

The pull developed is stated to be $B^2/8\pi$ dynes per cm. for the central gap. He then takes the area of the pole face, and states quite correctly that A B is the flux at the gap (central). From this the formula $F = k\,(E/c)^2$ is deduced.

What I wish to point out is that in magnets of this description the total pull is by no means equal to the pull calculated from the central gap, since there is in addition a quite considerable pull at the top of the armature, viz, that near parts marked P_2, P_3 in fig. 2. This rather spoils the simplicity of the formula arrived at, and the relation in question cannot hold unless the fluxes are distributed in a definite and constant manner over this area as well as the gap in question.

It would be interesting if Mr. Haigh could give a table of the pulls calculated from his formula and those observed. It will be found that the observed pull differs considerably for the reason above stated, and cannot be neglected.

In such cases I have often, by making alterations in the magnet system, obtained the necessary two equations enabling the two pulls to be determined.

W. H. F. Murdoch.

Mill Hill, *October 12th*, 1912.

HIGH-PRESSURE GAS v. FLAME ARCS FOR STREET LIGHTING.

[COMMUNICATED.]

The oft-cited experience of the city of Berlin is not valid in determining whether high-pressure gas lamps or flame arcs are economically the better for street lighting. The city has its own gas works, but no municipal electricity works, hence there is a great initial bias in favour of gas lighting. The question must be determined on a purely technical basis, and the following data, collected from practical tests and presented by Heyck in a recent contribution to the "Kommunalen Rundschau," are specially valuable, and show an undoubted advantage in favour of flame arcs.

High-pressure gas lamps develop about 2,000 c.p., and may be suspended from masts or span wires. The lamps must either be hung so low that they can be reached by a ladder, or flexible or jointed piping must be arranged so that the lamps can be lowered for cleaning and trimming. The first alternative results in very uneven illumination, while the second involves high capital cost, risk of leakage and derangement by frost, and frequent mantle breakage due to shock and vibration when handling the lamps.

Flame arc lamps (with inclined or vertical carbons) are the only type which need be considered in the present connection. From 1,500 to 3,000 or higher mean hemispherical c.p. is developed per lamp, and there is no restriction as to the height of suspension, for the lowering tackle employed is quite cheap, and is as effective for great as for small heights. The polar distribution of candle-power is of great importance in determining the uniformity of lighting effected. The inclined-carbon lamp with dioptric globe gives the best distribution; next comes the vertical carbon arc, while the pressure gas lamp has the most concentrated and least advantageous light distribution. For a given height of suspension and distance lamp to lamp, flame arcs give a much more uniform distribution than pressure gas lamps, and tests showing the contrary have been based on comparisons with obsolete types of arc lamps.

It has been found that the same average ground illumination can be obtained with pressure gas lamps of 2,000 nominal c.p., and inclined flame arc lamps of 1,700 hemispherical c.p. fitted with dioptric inner globes and opal outer globes. Lamps of these sizes are, therefore, compared below.

Capital Cost.—Including pipes and erection on a span wire or 8-m. mast, with the necessary flexible piping or joints, the cost per gas lamp averages £55-£60, and the interest and depreciation charges, at 15 per cent., amount to £8 10s. per annum. The cost per flame arc, including the erection of a span wire or mast at 9 m. above street level, is £36, and the annual interest and depreciation charges amount to £5 10s.

Attendance and Gas or Electricity Costs.—Assuming 2,000 burning hours per annum, the cost of lighting and extinguishing, mantle replacements, globe cleaning and renewals, and miscellaneous repairs, averages £4 10s. per gas lamp per annum. The corresponding charge per flame arc, including carbons and trimming, cleaning and repairs, is £4. At a moderate estimate, the gas consumption for this size of lamp will be 35 cb. ft. per hour, and the annual cost of gas per lamp per annum therefore $= 70\,6 \times g$, where g = pence per 1,000 cb. ft. A 1,700-c.p. flame arc requires 500 watts (including ballast loss), and the cost of electrical energy per annum therefore $= 1{,}000 \times p$, where p = pence per kw.-hour.

Excluding gas and electricity costs, each gas lamp costs £13 per annum and each flame arc £9 10s. per annum. The total cost per lamp per annum, assuming various values for g and p, is as follows:—

g.	Gas per lamp per annum (shillings).	Total per gas lamp per annum (shillings).	p.	Elec. energy per lamp per annum (shillings).	Total per flame arc per annum (shillings).
0s. 6d.	35	295	0·2d.	16·60	207
1s. 6d.	106	366	0 6d.	50·0	240
2s. 6d.	176	436	1·0d.	83	273
3s. 0d.	212	472	1·4d.	116·5	307
3s. 6d.	247	507	1·8d.	150·0	340
4s. 6d.	318	578	2·2d.	184	374

Electricity for street lighting purposes is very frequently supplied at 1·5d. per unit. In the above case, this corresponds to an energy cost of 125s. per lamp per annum, and a total charge of 315s. The fixed charge per gas lamp per annum being 260s., this leaves, in order to attain the same total annual cost, only 55s. for 70,600 cb. ft. of gas (*i.e.*, 9½d. per 1,000 cb. ft.). Electricity at 1·5d. per unit, employed, in inclined-carbon flame arcs with dioptric globes, is therefore equivalent, on a purely commercial basis, to town gas at 9½d. per 1,000 cb. ft. used in modern high-pressure gas lamps. From the illuminating standpoint, the electrical equipment is much the better, the "diversity"

factor being only half as great in arc as in gas lighting installations.

The general conclusion to be drawn from these comparisons is that flame arc street lighting is much cheaper than high-pressure gas lighting at the usual prices of electricity and gas. It is interesting to note that the standing charges (interest, depreciation and the various items included under attendance) equal the electricity and gas costs respectively when the price of electrical energy is 2·28d. per unit and when gas costs 3s. 8d. per 1,000 cb. ft. The energy or gas charges amount to practically 40 per cent. of the total in the above cases when energy costs 1·5d. per unit and gas 2s. 6d. per 1,000 cb. ft.

PROCEEDINGS OF INSTITUTIONS.

The Ignition of Coal-Gas and Methane by Momentary Electric Arcs.

By W. M. Thornton, D.Sc., D.Eng.

(*Abstract of paper read before the* Institution of Mining Engineers *at Newcastle-upon-Tyne, October 12th*, 1912.)

The conditions under which single electric sparks fail to ignite mixtures of gas and air form a question of the first importance in regard to the safe use of electricity in coal mining.

Wüllner and Lehmann investigated ignition by hot wires, and note the interesting fact that the gaseous mixture appeared to be ignited by iron and copper wires at the moment of fusion, at which point ionisation becomes active.

Heise and Thiem broke 196 small incandescent lamps, running at voltages from 65 to 220, in explosive mixtures of pit gas and air; their chief conclusion was that thick filaments were more dangerous than thin ones. They further examined the effect of opening switches in an explosive mixture of methane and air, making about 800 breaks in all, and found that ignition first occurred at 1·75 amperes on a 100-volt direct-current circuit. They concluded that voltage as well as current had to be considered, that fuses in melting fired gas always, that white-hot carbons did not, that the sparking of continuous-current motors when starting did, and, finally, that all visible sparks may be looked upon as dangerous, a point still generally accepted by mining men. A fuller research of a similar nature has recently been carried out by Prof. Lemaire, of Mons, Belgium, on both carbon and metallic-filament lamps. His conclusion is that the incandescent filament of any lamp, however low the voltage, will cause ignition if exposed in an explosive mixture.

The new Coal Mines Act of 1911 prohibits the use of electricity where more than 1½ per cent. of gas may be present, and limits the pressure to 20 volts in signalling circuits where the bare wires used may be touched together. It seemed well, therefore, to re-examine the whole case of the ignition of gas by single sparks such as may possibly arise in mining practice, especially at signalling voltages, with special reference to the influence of voltage, percentage of gas and of differences between direct and alternating current. To connect these with gas engine researches, experiments were also made with coal gas—that is, the usual town supply for lighting and power.

The occasions in which open sparking—as it is called—may mostly arise in practice are, when a power cable is broken by a fall, of roof, and on signalling circuits either at momentary or vibrating contacts. In all these cases the final separation is between points of metal. The simplest way of obtaining a spark between metals at a point which may be renewed is that used in the present work by making contact between two round wires touching at right angles. The arrangement of these and of the explosion vessel used is shown in fig. 1. The latter was of well annealed glass, 5·5 centimetres in diameter, and had a volume of 300 cb. centimetres. The vertical exit tube at the top was fitted after each explosion with a plug of cotton wool, the mercury then raised to the level of the inlet, the air in the pipe fully swept out by gas from the reservoir, the top of the tube closed with the finger, and the explosive mixture drawn in by lowering the mercury. After the chamber had been filled with gas, the vertical tube was further covered with an india-rubber cap, which prevented diffusion and blew off easily at ignition. The pole-rods could be rotated by hand through an arc of 90°, and the speed of separation was found by trial to be nearly the same throughout at 3·5 radians a second. A metronome, set to a convenient frequency, served to give uniformity in the make and break when desired.

The rods used were of iron, copper and nickel, the first to represent more especially the conditions of mining signalling wires, but to cover also the case of armouring in possible contact with live conductors; the second to give the case of breakage of a conducting wire; and the third chiefly as a control. To determine each point on the curves, observations of 600 breaks were on an average recorded, or over 50,000 in all.

The procedure was to guess at a current and to make a hundred contacts in succession. If no ignition occurred, the current was raised and the trials repeated. When a current had been found which gave ignition after the first few contacts, this was considered to be too high. The limiting igniting current was taken to be one which fired the gas within 50 sparks, slowly repeated. Near the critical current many trials were made, with fresh charges of mixture, 10 or more in difficult cases. Reliance is placed on the average from a great number of trials, and upon having the contacts in as nearly the same condition as possible throughout.

It being difficult to obtain pure fire-damp in large quantities, the first ignitions were made in a mixture of coal-gas and air.

In the case of mixtures of methane and air it was decided to make all trials in the mixture giving perfect combustion, that is, 9·36 per cent. The results are noted in Table I.

TABLE I.—Least Direct Current to Ignite a 9·36 per Cent. Mixture of Methane and Air. Atmospheric Pressure; Temperature 18° C.

Volts.	Amperes. Iron poles.	Copper poles.	Nickel poles.
50	4·00	4·000	4·00
100	1·05	0·900	1·15
240	0·40	0·175	0·55
480	0·10	0·050	0·15

At voltages below 50 the currents increase very rapidly, and it would appear to be impossible to ignite even the most explosive mixture of fire-damp and air by single break-sparks from a signalling circuit at the maximum voltage of 20 allowed by the Coal Mines Act. At these low voltages electrical signalling may be used with safety in any part of a coal mine, provided that care is taken to prevent wires from remaining in contact on short-circuit and, by local heating, from becoming red hot where they touch, an improbable occurrence. The bells should be preferably of the single-stroke pattern; no bell of the trembler type is safe in gas, unless the sparking contact is enclosed in an explosion-proof case.

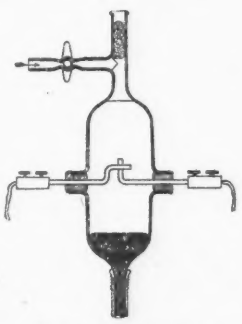


Fig. 1.—Explosion Vessel.

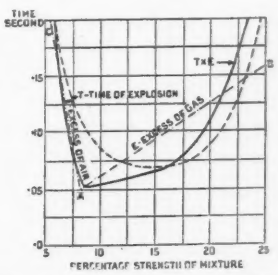


Fig. 2.—Suggested Synthesis of the Curves obtained.

In order to examine the influence of the size of the wire, the igniting currents of mixtures of coal-gas and of methane with air were found with poles of iron, copper and nickel in three sizes, at constant voltage. In all cases the igniting current is a linear function of the diameter.

The higher currents required at the larger diameters appear to be proportional to the surface of the metal in contact with the arc and to its cooling action.

With low-voltage apparatus, the inductance of the circuit is of the first importance from the point of view of safety at break. To examine this, inductances of from 0·0025 to 1·35 henries were placed in a 20-volt circuit and the resistance adjusted until the current just failed to ignite an 11 per cent. mixture of coal-gas and air. The small copper poles were used, with the results noted in Table II.

TABLE II.—Influence of Inductance on Ignitions. 11 per cent. Mixture of Coal-Gas and Air; Voltage, 20; Direct Current.

Inductance, in henries	1·53	0·76	0·325	0·217	0·108	0·069	0·056	0·013
Least igniting current, in amperes	0·27	0·5	0·75	0·93	1·4	1·65	2·05	3·75
Energy of arc, in joules	0·06	0·091	0·091	0·093	0·10	0·09	0·12	0·09

The risk of ignition increases rapidly as the inductance is raised, and no direct-current signalling circuit could be regarded as safe with a total inductance of 0·1 henry. In practice they have, as a rule, much less than this, and a typical mining signalling circuit connected through the explosion chamber failed to show any signs of igniting the most explosive mixture of coal-gas and air, when the contact was broken in it. The maintained spark at the spring contact in a trembler bell is known to ignite gas.

The least energy required to ignite the mixture remains nearly constant at about 0·10 joule. It is in thermal units about 0·025 small calories, equivalent to the combustion of 4·1 cb. cm. of coal-gas, or of 37 cb. cm. of an 11 per cent. mixture. At the highest inductance the energy was less, corresponding to the combustion of

21 cb. cm. of mixture. It is agreed that the cause of the period of induction observed in all gaseous explosions is the slow combustion of a certain volume of gas before enough heat is set free to enable the mixture to ignite itself; but there can be no doubt that the ignition of only a few cubic centimetres—in a test-tube, for example—is necessary to start an explosion. A similar pause is observed in coal-dust ignitions. With both gas and coal-dust it is longer when the source of ignition is an incandescent wire than with an arc, possibly to some extent in the latter case on account of the clear space around an incandescent wire in gases investigated by Lodge and Clark, but in the former more probably on account of the "combustion by stages" of the paraffins in the presence of hot wires. Momentary arcs of the kind considered here appear to ignite gas with difficulty, in comparison with the shattering sparks from condenser discharge.

The least current required for ignition in a circuit at a constant voltage varies considerably with the richness of the gaseous mixture.

With methane, the results were as follows (Table III):—

TABLE III.—Variation of Igniting Current with Percentage of Methane in Air. Voltage, 50; Small Iron Poles.

Percentage ...	...	5	6	7	8	10	12	13·5	14
Amperes ...	...	5	3·8	3·2	3·7	4·6	5·75	7·0	12

No ignitions could be obtained at 4 or above 14 per cent. The limiting values under the present conditions would appear to be 4·25 and 14·25. The limiting percentages of mixture may, and probably do, depend on the method of ignition, and upon the presence of small quantities of more highly combustible gases. In the present case analysis did not reveal any of these in quantities to be readily detected in the gas upon which the percentage experiments were made. Hydrogen or acetone, if present, was less than 0·2 per cent. In the final Report of the Royal Commission on Accidents in Mines, 1886, it is stated that "In some of our experiments an ignition, with all the characteristics of an explosion, has been produced throughout the whole of our apparatus by a Davy lamp, when the current contained very little, if any, more than 4·25 per cent. of marsh-gas."

The shape of the methane curve is very similar to that for coal-gas. There is first a sharp drop curved to a point, from which there is a linear rise to a less well-defined bend, above which the mixture rapidly become inert. The suggested explanation of this is as follows:—The two controlling factors appear to be (1) the "time of explosion," and (2) the reduction of sensitiveness to ignition by excess of either constituent of the mixture. In fig. 2, A is the most inflammable mixture. On either side of this the lines A-B and A-C give for any percentage the amount of dilution—to the left with air, to the right with the active gas, the upper limits being perfectly inert mixtures. The time of explosion, T, of a combustible gas is found in all the recorded cases to reach a minimum value, and to rise again as the strength of the mixture is increased. For petrol vapour the curve is a parabola symmetrical on either side of the minimum value; the time of explosion then increases as the square of the percentage excess of either air or vapour.

With coal-gas the curves of variation of T with richness of mixture are not so well defined. At the upper and lower limit T approaches 0·4 second; the minimum—which is very nearly the same in all the recorded cases—is 0·05 second at atmospheric initial pressure, and occurs at 14·5 to 16 per cent. On either side of this T increases with excess of gas or air, but the branches are not usually symmetrical. No figures are available for methane, but the reciprocal of the velocity of explosion gives a curve similar in character, with a minimum at 13 per cent. In every case of a combustible gas mixed with air, the time of explosion reaches a minimum in a mixture several per cent. richer than that required for a perfect combustion. The curve of T lies between the upper and lower percentages limiting ignition, and is shown in fig. 2 symmetrical within them. The product of the excess of gas or air and the time of explosion is a curve agreeing closely in shape with that of the observed least igniting current. It would appear from this that these are the chief, if not the only, factors which determine the direct current or power required for ignition when the voltage and poles remain the same. This relation remains much the same when the duration of the arc is increased by the use of higher voltage, although an examination of the influence of voltage with different strengths of mixture indicates that it is only below about 150 volts that much difference in the igniting currents is to be expected. At this point, also, the difference in the duration of the arcs begins to increase.

In the previous work, the influence of the time of duration of the spark, although masked by that of voltage, has been always in evidence. It was to be expected, therefore, that very different values from the above might be obtained by the use of alternating currents. The first experiments on this were made at 40 periods with coal-gas and air, and with the same density of mixture (11 per cent.) throughout. To avoid disturbing effects, pure sine waveforms were used. The currents required for ignition were all much greater than the direct currents at the same voltages, the ratios of alternating to direct being as shown in Table IV.

TABLE IV.—Ratios of Least Alternating to Least Direct Igniting Currents. Coal-Gas and Air, 11 per Cent.; 40 Periods, Non-Inductive Circuits.

Volts ...	...	...	50	100	200	300	400	500
Rates, A.C./D.C.	...		3·0	4·9	6·2	9·0	10·8	12·5

There may be, therefore, a very real increase in safety from gas ignitions by the use of alternating currents compared with direct, although when open sparking does occur it is generally in excess of the minimum values found here. An interesting result followed the addition of small inductance (0·0025 henry) to the circuit. At the higher voltages, which were first examined, a perceptible but not great diminution of the igniting current was observed. At 200 volts the difference was greater, although the ratios were much the same, but at 100 volts there was evidence of an unexpected drop. At 50 and 25 volts the gas was more readily fired than at 100. No variation in the conditions, such as polishing the poles or making fresh mixtures of gas and air, changed the result. The flattened form of the curve suggests some instability similar to that familiar in the liquefaction of gases by compression. With copper rods, under the same conditions of frequency and density of mixture, the addition of the same inductance produced a similar divergence in the curves at about the same current, but both non-inductive and inductive curves now show a flattening beginning at about 200 volts as the voltage is lowered. Both curves are remarkably deflected between 50 and 100 volts, and again at the higher voltages. There is clearly some critical condition introduced by the use of alternating current in all these cases, or rather a third factor of equal importance with voltage and current. The influence of inductance on the iron curve further suggested that time might be this factor, and that the shape of the curves might be greatly affected by the frequency of the current.

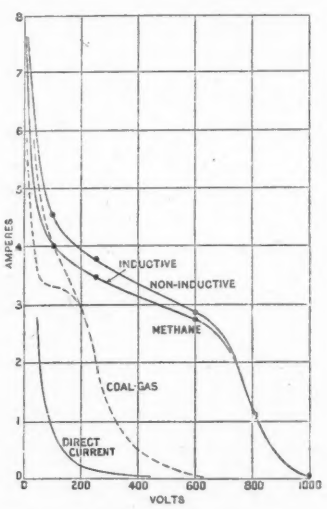


Fig. 3.—Alternating Igniting Currents for Methane, 9·36-per cent. Mixture. 40 Periods per Second. Copper Poles.

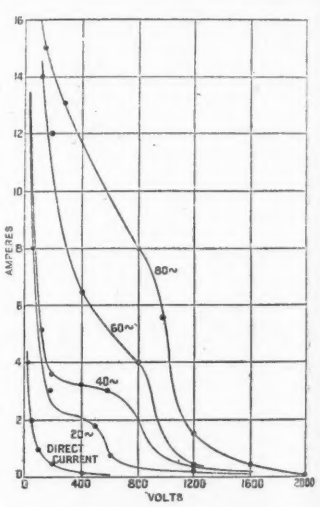


Fig. 4.—Influence of Frequency on Igniting Current in a 9·36 per cent. Mixture of Methane and Air. Iron Poles.

Frequency is not, however, the only important factor, for the currents for iron and copper, although similar, are not identical, and the difference is still further brought out with nickel poles. The currents here are less than for either iron or copper, and so differ from the results with direct voltages. There is also in this case a remarkable sensitiveness to the composition of the gas.

With copper poles (fig. 3) and at low voltage, the currents are rather greater than with iron; at the higher voltages they are lower, but the curves are very similar in shape. Both with coal-gas and methane the igniting currents are much lower with nickel than with iron or copper poles.

Experiments were made to ascertain the least igniting currents at various frequencies in 9·36-per cent. mixtures of methane and air, with small iron poles, and non-inductive circuits throughout. The results are given in fig. 4. The influence of increase of frequency in raising the least igniting current, when the frequency is low, is very marked; there appears to be a critical point between 40 and 50 periods and at about 100 volts. The figures are given in Table V, on the next page.

As previously mentioned, the initial period of induction always recorded in experiments on gaseous explosions provides an explanation of the influence of frequency on ignitions of the kind considered. The full "time" of explosion is rarely less than 0·05 second, and the period of induction is generally of this order. When the contacts are separated, the arc which is formed has to restart itself across the gap after passing through its zero value, and unless the air is being strongly ionised, a small gap suffices to prevent the

TABLE V.—Influence of Frequency on Least Ignition Currents. Methane, 9·36 per cent.; Atmospheric Pressure.

Frequency ...	20	40	60	80
Volts.	*Amperes.*	*Amperes.*	*Amperes.*	*Amperes.*
50	8·00	8·50	—	—
100	3·80	5·00	14·0	15·00
200	3·00	3·50	12·0	14·00
400	2·20	3·25	6·5	11·50
600	0·70	3·00	5·0	9·60
800	0·35	2·00	4·0	8·00
1,000	0·25	0·40	0·3	5·75
1,200	0·20	0·25	0·2	1·40

arc from restarting. If the break begins when the current is just passing through zero value, there will be no arc at all; if at a crest or maximum value, the arc is greatest at the start, but is falling as the poles are separated; and unless the initial current is sufficient to have strongly ionised the gap, the current, on reaching zero, will be unable to re-form the arc in the opposite direction. The most favourable point in the cycle for the break to take place, in order that an arc should be formed with minimum energy, is on the rising side of the current wave.

It is evident that at the lowest circuit voltages the current must be large in order to cause ignition by the liberation of a greater number of ions from the material of the pole. When, however, the maximum voltage gradient approaches 40,000 per cm., as it does on a 500-volt system at 0·017-cm. length of arc—that is, within a third of a period at a frequency of 40—the arc will be maintained whatever the current may be, and small currents then ignite the gas. At voltages between these limits of ionisation by large currents on the one hand or high voltage on the other, the igniting current must be controlled by both; and since it has been shown that there is in the case of methane an evident relation between duration of arc and current required for ignition, the simplest expression taking account of duration and voltage is that the current is inversely proportional to the product of voltage and time of duration. The influence of the alternation of the current can be regarded as that of a time-filter or screen which retards the influence of voltage and brings out that of time of duration of the arc.

It is probable that the fact of alternation has less influence with longer periods of induction. This can, in fact, be shown experimentally by working with very dilute mixtures, in which the time of explosion is much longer.

It may be concluded that when the duration of an arc approaches the period of induction of a gaseous mixture, ignition becomes increasingly difficult.

All the foregoing results are for currents in circuits opened by a single clean break.

In conclusion, it may be said that, for the same voltages, the ignition of gaseous mixtures by direct currents would appear to depend chiefly upon the material of the poles, and ignition by alternating currents upon the nature of the gas.

The use of low-voltage alternating currents for signalling purposes gives a much greater margin of safety than is possible in direct-current working.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"Installation Work" writes:—"I shall be glad to have your legal contributor's opinion on the points raised below, which are continually arising in connection with electrical installation work, as there seems to be no definite decision available at present:—

"(*a*) Have the electrical department of a Corporation any authority to require an installation to be wired with 2,500-megohm C.M.A. grade cable, when 600-megohm ditto has been specified by the consulting engineer?

"(*b*) Can they reasonably insist on S.P. main fuses being earthed, when their own cut-outs and meters are not so treated? Personally, from past experience, I have always found it more dangerous to earth the cast-iron cases of main fuses, and as a matter of fact, this is absolutely prohibited by the Corporation of Glasgow.

"(*c*) Under what regulation or rule can they insist on 6-ft. space being maintained between the outers of a three-wire supply? It seems very illogical to insist on a distance of 6 ft. between the two wires in the meter room, and then bring the same wires into a D.P. switch where they cannot possibly be spaced more than 3 in. apart.

"(*d*) In one case, I have been debarred from fixing the motor-generator in the lantern room on the ground that the motor was connected to a 200-volt circuit (Home Office Rules restrict pressure to 100 volts on a projector arc circuit), while no objection was raised to fixing a similar switch, operating on the same voltage, to an extract fan motor.

"(*e*) The position with reference to the clause "Completion of Contract" of a contractor who puts non-union men on to the job, and then receives notice that the other tradesmen will strike, unless he substitutes union men for those he has previously employed."

*** As to (*a*), and the following two queries, it does not appear to be quite clear whether they relate solely to the supply of electricity in a cinema theatre. So far as is known, the only regulations dealing with such a supply are those made by the Secretary of State under the Cinematograph Act, 1909 (February 18th, 1910), and these do not appear to touch upon any of the points mentioned. As to these queries it is difficult to answer them without any information as to the provisional order or Special Act under which the Corporation supplies or makes rules for the supply of electric light. With regard to query (*b*), is not this governed by Rule 39 of the Regulations made under the Electric Lighting Acts, 1882 and 1888, which provides that "All electric lines and apparatus placed on a consumer's premises shall be highly insulated and thoroughly protected against injury to the insulation or access of moisture, and any metal forming part of the electric circuit shall not, unless efficiently connected with earth, be exposed so that it can be touched? All electric lines shall be so fixed and protected as to prevent the possibility of electrical discharge to any adjacent metallic substance." The questions (*a*), (*b*) and (*c*) could be much more satisfactorily answered if the querist would apply to the Corporation for a copy of their rules, and also for a copy of the special order under which those rules were formulated.

As to (*d*), Clause 12 (*c*) of the Cinematograph Theatre Rules above mentioned, provides that:—"Cables for cinematograph lamps shall be taken as separate circuits from the source of supply, and from the supply side of the main fuses in the general lighting circuit, and there shall be efficient switches and fuses inserted at the point where the supply is taken, and in addition an efficient double-pole switch shall be fitted in the cinematograph lamp circuit inside the enclosure. When the cinematograph lamp is working, the pressure of the current across the terminals of the double-pole switch inside the enclosure shall not exceed 110 volts." The pressure of "100" volts does not appear to be mentioned in these regulations.

With regard to (*e*), if the usual strike clause is to be found in the contract, it appears to be clear that the contractor would not be liable for the delay occasioned by a strike, even if that strike were brought about by his employing non-union men. For instance, the form of contract sanctioned by the Institution of Electrical Engineers provides (by Clause 38) for delay caused by (*inter alia*) "general or local strikes or lock-outs, or combinations of workmen." This is done by the engineer, on application, granting such extension of time as may appear to be reasonable. In the absence of a strike clause, however, it is to be feared that an employer who has undertaken to carry out works within a specified period is very much at the mercy of his workmen.

PROPOSED ELECTRICITY EXTENSIONS AT LEEDS.

One of the matters to be dealt with in the Bill which the Leeds Corporation intends to promote in the next Session of Parliament is the acquisition of a site for a large new generating station in connection with the supply of electricity in Leeds.

Mr. Harold Dickinson, the manager of the Electric Supply Department, has presented a report to his Committee setting out the reasons why such a step is desirable. It states that the capacity of the plant now installed at the works in Whitehall Road is 15,440 kw., and an additional turbo-generator is on order with a capacity of 7,500 kw., while still another generator of the same capacity can be accommodated at the Whitehall works, bringing up the total capacity to 30,440 kw. Allowing for spare plant, it is suggested that this would not enable the Corporation to deal with a greater load than, say, 20,000 kw.

The maximum load which the station has had to bear up to December last was 9,570 kw., and the additional orders since received make it probable that the load in December this year will reach 12,000 kw. Assuming the increase to continue at the same rate, the capacity of the works will be fully taxed in the year 1915, and it is regarded as quite probable that the rate of increment will be considerably augmented. It follows that further plant must be available by the winter of 1915-16, and it is suggested that three years should be allowed for preliminary negotiations, land purchase and the design, building and equipment of a new station.

Mr. Dickinson discusses the alternative courses of reconstructing a portion of the present buildings, so as to accommodate a plant of larger capacity, and possibly purchasing adjoining land for further extensions; and purchasing land at a distance from the present station and erecting additional works there.

The first point to be considered is the amount of business which the department may reasonably be expected to have to deal with within a measurable space of time, and Mr. Dickinson sets out numerous facts and calculations with a view to the elucidation of this point. An interesting table shows that the estimated amount of motive-power used in Leeds for industrial, commercial and domestic purposes is 155,585 h.p. Out of this 17,472 h.p. is furnished from the Corporation's Electricity Supply Department, the greater part of which—10,136 h.p.—is supplied to engineering works, while the printing trade also takes 1,531 h.p. The figures given are correct up to March 31st last; the total h.p. now connected is over 20,000.

The textile manufacturers in the city are estimated to have 19,500 h.p. of engines installed, and up to the present the motors installed in such mills have a total capacity of only 270 h.p. Mr.

Dickinson is of the opinion that the prices charged for electricity are now getting to a point where the textile user will be attracted, and he refers to the applications now being received for this class of work, as evidence in support of his opinion. He looks forward to the time when it will pay the user, in practically all cases, to take his supply of power from the Corporation, and anticipates an increase in the demand for current to be used for lighting purposes and cooking and heating. Other possibilities are the supply of all the current used in connection with the tramways from the main power station, and the electrification of railways, and without taking the latter item into account, Mr. Dickinson anticipates that the Corporation may be called upon to provide, in the next 10 to 15 years, for a total load of 57,900 KW., but in order not to appear too optimistic he bases his proposals upon an assumption that a maximum load of only 40,000 KW. will be attained within the period mentioned.

The report contains a number of charts to illustrate the progress that has been made. It is theoretically possible to extend the Whitehall Road works so as to accommodate machinery with a total capacity of 66,600 KW, which, after providing for the necessary reserve of plant, would allow a maximum load of 46,100 KW. to be dealt with, but Mr. Dickinson calls attention to a number of reasons for his conclusion that such a course would not be the most satisfactory that could be followed.

For instance, he anticipates that 164,000 tons of coal will be used in a year, and in order to obtain this large quantity it is desirable to be in a position to purchase for delivery either by rail or water. There is also the question of storage to consider, and it is suggested that accommodation should be available on the site for at least a three months' stock, say, 45,000 tons in the winter, whereas the capacity of storage at the present works with the greatest possible extension would not exceed about 10,000 tons.

By the adoption of another site suitable for obtaining coal from a wider area, an advantage in the cost of coal would be secured, varying according to different conditions from £2,084 to £4,166 yearly.

Another argument in favour of a new site is that as a very large proportion of the increased load upon the works will probably arise in connection with the supply of power in the Hunslet area, a considerable saving in the cost of cable, estimated at £30,000, would be effected by the provision of works in that district.

Among the minor, but still important factors, to be considered is the possibility of combining refuse destruction with the generation of electricity, and it is estimated that if a suitable site were chosen, about 500 tons of refuse per day could be dealt with in such a way as to produce steam sufficient for the generation of 17,000,000 units per annum, which would otherwise involve a consumption of about 27,000 tons of coal yearly. Such a combination would be quite impossible at the Whitehall Road works.

Another point is that the risk of an entire breakdown is very largely reduced by having two generating stations instead of one.

The extension of the Whitehall Road works to their utmost capacity would involve an outlay of £546,000, whereas the provision of a works at a new site, and with the same capacity as the extended Whitehall Road works, would cost £595,000. The difference between the two sums is accounted for by the additional provision for coal storage and handling, railway sidings, and the much larger area of land. This larger area would, of course, leave room for extensions which might be necessary in order to cope with requirements over and above the 40,000 KW. assumed as the maximum load, and it would, in addition, provide space for a destructor.

Mr. Dickinson gives figures indicating that the annual expenditure upon two separate stations, would be, after allowing for contingencies, £2 000 more than in one large station, but against this should be set the extra cost that would be incurred if offices and cable and coal stores had to be provided at a distance from the generating station.

In summarising his report, he repeats that his calculations only refer to an output which is confidently expected to be attained within 15 years. After that time further increases will still have to be provided for, and if there is doubt as to the possibility of dealing at the present site with the problems arising out of the supply that has been contemplated, the difficulties after that period will be enormously increased, and it would certainly then be necessary to erect works upon another site.

In conclusion, Mr. Dickinson expresses the opinion that the balance of advantages is in favour of the erection of a new station upon a separate site after the present engine house is filled up with plant, and recommends that steps should be taken forthwith to obtain powers to acquire the necessary site, and this recommendation has been endorsed by the Tramways and Electricity Committee.

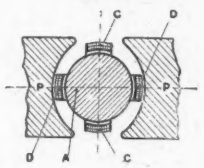
NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The Omega.

Under this name Mr. Robt. W. Paul, of New Southgate, London, N., is now introducing a new portable self-contained insulation meter, comprising, in one case, a generator, together with a moving-coil ohmmeter of novel construction, designed by Mr. G. W. Harris.

As is well known, the usual moving-coil construction in true ohmmeters, comprises two narrow-limbed coils, similar to those used in moving-coil voltmeters and ammeters, mounted on a common spindle at an angle to each other, and pivoted in an uneven magnetic field. This general arrangement is shown in sectional diagram in fig. 1, where C C are the limbs of the control

Fig. 1.



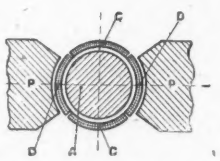


Fig. 2.

coil, D D the limbs of the deflecting coil, A is the iron core, and P P are the magnet pole-pieces. On the passage of a current through C, the system takes up the position shown. If now a current passes through D, the whole system will rotate, D moving into a weaker part of the field, and carrying C into a stronger part, until the torques balance.

Since the current in C is arranged solely to depend upon the testing pressure, and that in D upon the current through the resistance under test, the position for balanced torque, depending as it does upon the relative strengths of these currents, is a measure of

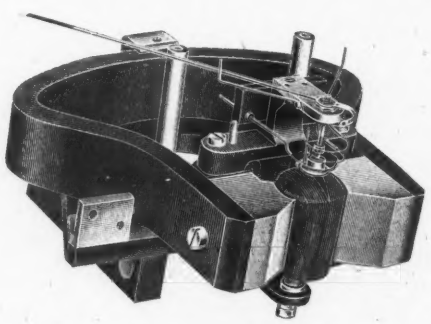


Fig. 3.—Mechanism of the Omega.

the value of such resistance, and is independent of change in testing pressure, since both currents will vary in the same proportion with this pressure. Consequently the scale can be marked off in values of resistance.

The Omega system differs from this, in that coils with wide angle limbs are used, working in a substantially even and concentrated field, turns in one winding moving out of the field while turns in the other move into it as the moving system rotates, until the

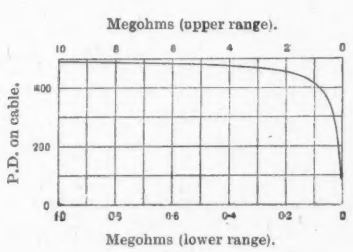


Fig. 4.

balance of torques is reached. The principle will be made clearer by reference to fig. 2, which shows a horizontal section through an Omega movement, with core and pole-pieces. The control coil C C and the deflecting coil D D are wound at right angles to each other on a single hollow cylindrical former, the coil limbs each subtending an angle of 90°. The windings thus cover the whole surface of the former. The fixed iron core A is supported on a stem passing through an aperture in the bottom of the former, which is pivoted on an axis concentric therewith. The ends of the former are dome-shaped, making a very strong and light construction.

As before, on the passage of a current through the winding C, the system will take up the position shown. If a current now passes through D, the whole system will rotate, coil-turns in D

passing from under the pole faces and bringing coil-turns in C under their influence until the balance of torque is reached. The complete system is illustrated in fig. 3.

A comparison of the figures shows that the increased winding space in the Omega ohmmeter, fig. 2, gives a much greater number of active turns in the deflecting coil D; the concentration of the field resulting from the narrow pole faces still further increases the deflecting forces. In this arrangement, therefore, increased

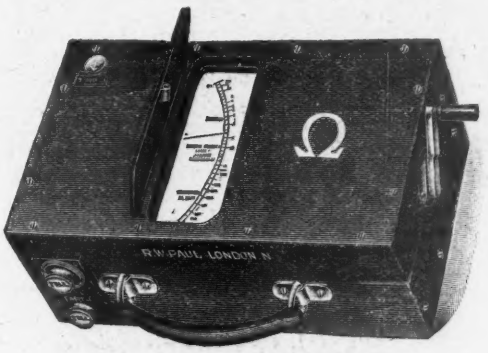


Fig. 5.—The Omega.

force is gained both by the increase in the number of ampere-turns and the increase of field strength, the total advantage being proportional to the product of the two gains.

One result of the improved construction is that it is possible to construct an instrument measuring up to 400 megohms (at the mark next to INF) using a 100-volt generator, or up to 2,000 megohms using a 500-volt generator. This is a much higher figure than is usually demanded in practice, a top reading of 20 megohms per 100 volts of testing pressure generally sufficing, in which case there is a large margin of reserve force.

In the Omega, the indications prove to be little affected by external magnetic fields, so that compensating devices or magnetic shields are entirely unnecessary. The calibration curve over the whole angle of deflection has a convenient characteristic for resistance measurements from 0 to INF. It is not necessary to include a high internal resistance in series with the deflecting coil in order to utilise only that part of the scale which has a suitable characteristic. The Omega needs only sufficient internal resistance to prevent an excess of current in case of a breakdown in the cable under test. Therefore, the greater proportion of the pressure is available on the insulation.

This is illustrated in fig. 4, which shows the small internal loss of pressure when measuring low resistances. This curve was obtained on an Omega having a generator of 500 volts and a range to 100 megohms.

The standard ranges cover measurements from ·0005 to 200 megohms, but special instruments are made for much higher insulations; the generator most used gives 500 volts testing pressure, but generators are also made to give 250 and 1,000 volts.

Each Omega has an upper and lower range, the latter being put into operation by depressing a plunger; this plunger is held down by being slightly rotated. With the plunger in this position the readings on the scale are to be divided by 10. The pointer gives correct indications at almost any speed of the generator, and comes smartly up to the reading, the movement being critically damped.

There are no loose or detachable parts on the Omega, nor any projecting parts liable to damage; the terminals are of a novel type, and grip the connecting wires by a spring action either in a hole or between two flanges. The pivots are practically indestructible, and the whole apparatus is constructed for hard and continuous service.

In addition to the insulation-testing Omega, the principle above described is being applied to other electrical measurements.

Simplex Stage Plug and Socket.

A plug having a capacity of 50 amperes has been introduced by Simplex Conduits, Ltd., of 176, Charing Cross Road, W.C., for stage work or for power appliances generally in factories, and so forth. It is designed to comply with the latest requirements and the most

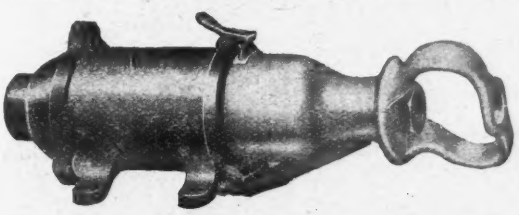


Fig. 6.—Simplex 50-ampere Plug and Socket.

up-to-date practice. The body is cylindrical, and is made in two pieces; the main casting is tapped at one end for conduit up to 1½ in. diameter, and has four lugs for fixing. Inside is a specially shaped and prepared fibre piece, which carries the terminals for connecting the main circuit wires and the plug pins. This fibre, which gives very high insulation resistance, is held in position by a key cast on to the inside of the body. The plug is of aluminium and of the three-pin type, the third pin being used for earthing, and enters the side of the cast body of the socket. A hinged spring cover is fitted, which closes the socket holes when not in use, being held fast by a spring catch, which is also utilised to hold the plug firmly in, when this is in position. All the terminals are of ample size, and the design generally is on liberal lines.

Sealing-wax Heater.

The British Prometheus Co., Ltd., of Salop Street Works, Highgate, Birmingham, have sent us particulars of their new pattern sealing-wax heater, which is suitable for commercial houses. This heater is made with a polished copper body and brass fittings, and has the advantage of an adjustable cast-iron stand. The con-

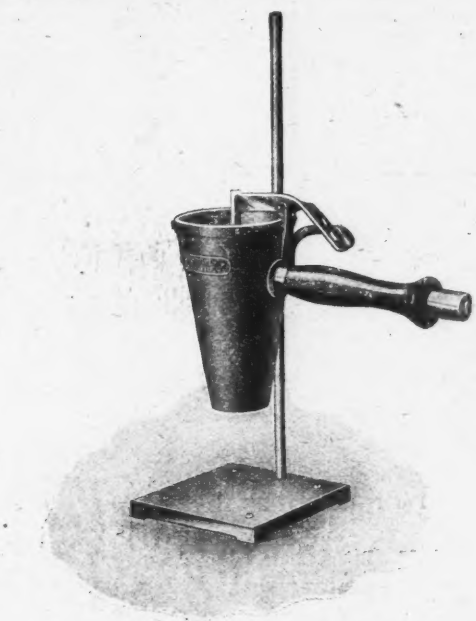


Fig. 7.—Sealing-wax Heater.

sumption is 80 watts, which permits of this heater being worked off the ordinary lighting circuit. The trigger provided allows the supply of wax to be regulated as desired. There is with this type of heater an entire absence of fire risk; the heater is also portable.

A New Self-Regulating Constant-Current Dynamo.

The dynamo, illustrated in section in fig. 8, is of novel and ingenious construction, and can be adjusted to maintain a given output, such output being kept constant through a considerable range of speed. The principle of construction is simple, and can be

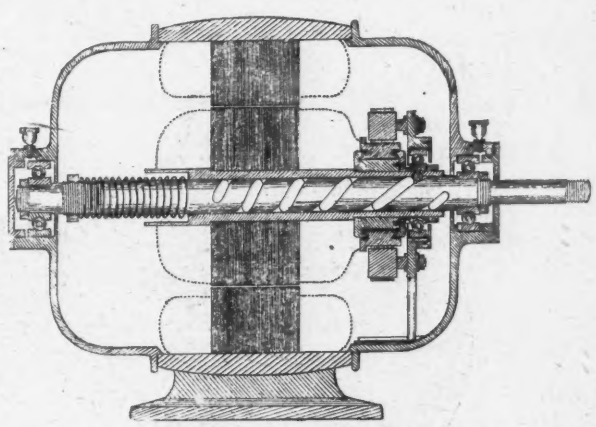


Fig. 8.—Self-Regulating Constant-Current Dynamo.

adapted for many purposes where automatic control and regulation of output is essential.

The armature and brush gear is built up on a sleeve which is mounted on the shaft, and driven by balls which engage in spiral grooves cut in the shaft; the armature is held in position between the pole magnets by a coil spring, which is partly recessed in the sleeve, the tension of which is adjusted by a nut. When the dynamo has attained a speed sufficient to give the required output, the reaction between the armature and the field magnets will cause the armature to wind along the shaft and partly compress the spring, leaving its normal position and moving to a region where

it is traversed by a smaller magnetic flux, thus automatically taking up a position compensating for the increase of speed. The same action takes place on reduction of speed, but in the opposite direction, the armature winding itself back into a stronger field. It is claimed that the voltage remains constant from 800 to 3,800 R.P.M., and the machine is specially suitable for the lighting of motor-vehicles; it is very economical in its action and can be constructed for either a forward or reverse drive. Further particulars can be had from the inventor, Mr. A. A. Price, 28, Rathbone Place, W.

Adams Igranic new Self-Acting Rheostat.

The new "Z" type self-acting rheostat recently developed by the Adams Manufacturing Co., Ltd., of Bedford, is suitable for controlling small D.C. motors up to 3 H.P., and is a considerable improvement on their old "Leaflet 29" type of apparatus in several details. In the "Z" type there are always four steps, one of which is used for making the circuit and the others for controlling the starting resistance, and all these make contact by pressing two surfaces together, so that there is no sliding contact at all. Another point is that in the "Z" type the speed of starting is fixed by adjustment of the dashpot, and is the same whether the load

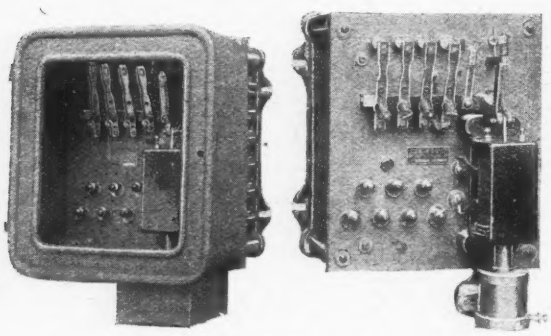


Fig. 9.—Adams "Z" Type Starter.

is heavy or light. Being an air dashpot, it is not affected by changes of temperature, but may be relied upon to act always in the same way.

In the old starter the speed of starting depended upon the development of the back E.M.F. of the motor, and this introduced difficulties under widely varying loads, such as are common in connection with lifts, &c. The "Z" type starter, which is illustrated in fig. 9, has none of these disadvantages, and is a robust and reliable piece of apparatus. It can be used for automatically controlling electrically-driven pumps, air compressors, lifts, or for remote control, and can be operated by means of a single-pole float switch, a pressure regulator, a start and stop push-button box, or an ordinary tumbler switch. The control circuit is not the main circuit, but a pilot circuit, which only carries a fraction of an ampere.

Remote control from two or more points can be obtained by the use of suitable accessory switches, and in combination with the reversing switch the new self-starter makes a very cheap, and at the same time thoroughly efficient lift controller for small service lifts up to 3 H.P.

Walsall Meters.

The Walsall Electrical Co., Ltd., of 57, Bridge Street, Walsall, have during the last nine months commenced manufacturing small meters to compete with those which have been sold in this country of foreign make, and are turning them out at present at the rate of 300 per week. These instruments are identical

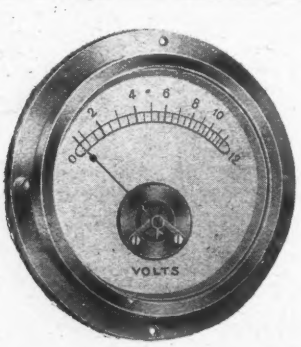


Fig. 10.—Walsall Voltmeter.

in construction, with the exception that one has a closed front suitable for rough usage, and the other has an open front (fig. 10).

The makers claim the following advantages over the foreign-made meter: that their meter is absolutely rainproof, the glass being fixed into the case with a rubber buffer in the shape of a ring, and not so liable to be broken; only enamel wires are used for the coils, which are liberally rated; where the leads come through the meter case, ebonite bushes are moulded into the apertures, and there is no possible chance of breakdown; each dial is calibrated and marked off by hand; the movements are accurately balanced, and are also inspected before being inserted into the meter.

In spite of the extra cost which these various improvements have entailed, owing to the special machinery the makers have designed to produce these meters, and the system they have inaugurated, they are able to supply these instruments at the same prices as their foreign competitors. Their new catalogue can be had on application.

Hot Bar Radiators.

Every season the Dowsing Radiant Heat Co., Ltd., of 105, Great Portland Street, London, W., introduce some new design in the department of electrical work in which they have so long specialised—electric radiators. The list issued by them this week for the 1912-13 season contains as one of its special novelties several styles of new hot-bar radiators, which they claim to be a great advance in electric heating apparatus. We illustrate one of these designs in fig. 11. The radiator is composed of hot bars, the

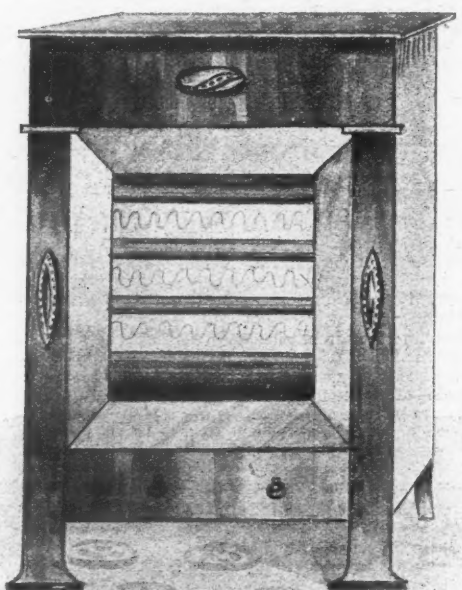


Fig. 11.—Dowsing Hot-Bar Radiator.

appearance of which, when heated, resembles the pleasant glow of a bright coal fire, although possessing all the advantages of electric heating over the old method. The radiator shown has three patent hot-bar heaters, and is in an oxidised copper frame fitted with patent coppered reflector. Another type (No. 802) has four bars and a polished copper frame, while a third (No. 800), has a black iron and copper frame, and is fitted with a boiling plate.

Benjamin Fittings.

A number of new fittings built up on the Benjamin wireless cluster principle are described in the new list issued by the Benjamin Electric, Ltd., of 117, Victoria Street, S.W., and data are given respecting lighting work in which they can be

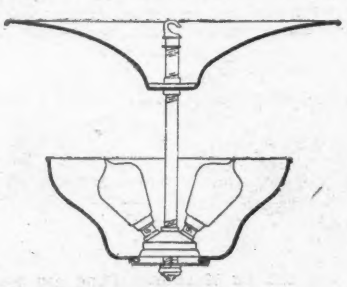


Fig. 12.—Benjamin Inverted Reflector Fitting; Section.

successfully applied. Our readers are already fully familiar with these wireless cluster bodies, which, with their associated devices, are covered in Section I; enamelled steel and opal reflector fittings, tungsten arcs, Holophane-Benjamin steel reflectors of extensive,

intensive, and focusing types, also outdoor lanterns, cargo lights, and "Benco" weatherproof fittings occupy Section II. In the next Section III, which is devoted to office and indoor lighting, we notice the inverted reflector type (shown in figs. 12 and 13) which is designed for use with three or four 100-c.p. lamps with a 22-in.

Fig. 13.—Benjamin Inverted Reflector Fitting.

white enamelled top reflector and an opal reflector bowl 17½ in. by 8 in. These fittings can be supplied in either parallel, series or divided circuits. Later sections show various fittings for shop window, show case and picture lighting, colour-matching and light-measuring apparatus, the lightometer, and a collection of globes, reflectors, &c.

LEGAL.

The National Telephone Arbitration.

In the King's Bench Division on Tuesday, October 15th, the Railway and Canal Commission resumed the hearing of the arbitration between the National Telephone Co. and the Postmaster-General, to determine the price to be paid by the latter for the acquisition of the National Telephone Co.'s undertaking. The Commission consists of Mr. Justice A. T. Lawrence (president), Sir James Woodhouse, and Mr. Gathorne Hardy. At the commencement of the main arbitration proceedings last sittings, the claim amounted to over 20 millions, but during the many days of exhaustive examination and negotiations which followed both inside the Court and out before the summer vacation, that huge figure was materially reduced.

The counsel engaged are:—Sir A. Cripps, K.C., Mr. Danckwerts, K.C., Mr. Forbes Lankester, K.C., Mr. E. Morten, K.C., Mr. H. H. Gaine, and Mr. Aubrey T. Lawrence, for the company. The Attorney-General (Sir R. Isaacs, K.C., M.P.), the Solicitor-General (Sir J. Simon, K.C., M.P.), Mr. Buckmaster, K.C., M.P., Mr. Schwabe, and Mr. Branson, instructed by Sir R. Hunter for the Postmaster-General.

Sir A. Cripps, at the commencement of the proceedings, said the Court would recollect that it was stated in the course of the last hearing in regard to certain items of value or prices, that there was not a great deal of difference between the parties. He was glad now to be able to tell his Lordship that with regard to part of the case an arrangement had been come to, and figures agreed upon between the parties. He was bound to say there never was any great difference between them on these figures, but other matters of a highly argumentative character would have to be dealt with in due course. The arrangement he had mentioned meant that a figure of £10,313,765 had been agreed upon between the Post Office and the National Telephone Co. The figures with regard to depreciation, &c., had not been considered; the above agreement was in regard to what they called the fundamental cost of construction.

Sir J. Woodhouse: Do you mean the cost? We have had a statement with regard to the matter which gives figures for "cost," whilst the statement you have just handed in speaks about "value."

Sir A. Cripps: I do not think there is any confusion about it at all.

Mr. Justice Lawrence: So long as you are agreed upon that, it is all right, but this document does not show it.

Sir A. Cripps: It means value before depreciation. There is no question about it between the parties.

The Attorney-General agreed that there was no difference between them on the matter. The cost of construction and figures of value involved the question of depreciation. Here they were simply dealing with the cost of construction.

His Lordship: But it does not say so.

Sir A. Cripps: If I may be allowed to go on with my explanation, the Attorney-General and myself are absolutely agreed, and there is not the slightest question as to what the arrangement means.

Mr. Justice Lawrence: Well, there is this difference, we are disappointed.

Sir Alfred, proceeding to deal with the table of agreed figures, said the first item, including materials supplied, manufacturers' profit, wastage, &c., and coming under the heading "cost of material," amounted to £7,016,500. Another item upon which at one time differences were threatened, but which had now been agreed, was that of freight, including cartage, &c., and the figure in this case was £377,904. Other matters agreed upon were wages and expenses up to and including gang foremen and casualty insurance. What had been included in these agreed figures was the cost or value before depreciation. Of course, as regarded the cost of depreciation, the parties were not at one. Among the matters still outstanding, Sir Alfred mentioned storing material, temporary storage and cost of raising capital, additional charges of obtaining subscribers' agreements, plant recovered after the day on which the inventory in any centre was taken, &c.

Sir J. Woodhouse said he had been devoting his time to getting a mass of figures into his mind, and now he had to start with a fresh lot of figures.

Sir Alfred Cripps: The object of the amended figures is not to get rid of pleasant memories in the past.

The Attorney-General: It is the result of my learned friend's long-vacation work.

Sir James Woodhouse: Do you think if you had another vacation you could agree to the rest of the figures?

Sir A. Cripps: It would have to be another long vacation.

Continuing, Sir Alfred said the total estimated cost of construction partly agreed to came to £18,133,193. Upon the adjustment, the company's claim for conduits was put down at £2,337,971. Other items of agreed fundamental cost were underground cables, £1,856,753; poles and standards, £1,284,343. Aerial cables were depreciated from £889,594 to £616,849; exchange equipment and central batteries from £1,512,739 to £1,363,621; and subscribers' charges appeared at the depreciated figure of £2,952,444.

The Solicitor-General then proceeded to deal with the figures and show how they were to be used. The company's cost of construction, which was originally £19,550,000, was now £18,133,000. On the other hand, the Post Office figure was £11,617,000 originally, but, as a result of the agreement, the Post Office took the view that that figure should be advanced to £12,143,000. It was true there was still a considerable chasm between the parties to bridge over, but it was satisfactory to find that the two armies were not running away from each other. The two large subject matters upon which there was no agreement was what was the proper addition to be made to the fundamental cost, in order to arrive at the total cost of construction; and, secondly, having arrived at that cost of construction, what was the proper amount of depreciation to be allowed in order to arrive at the figure of value which would be the award.

(*To be continued.*)

Lift Accident.

On Monday last, at the Westminster County Court, a clerk named Askhan was awarded £25 and costs against the London Electric Railways Co., Ltd., for injuries to one of his feet, which, owing to his being pushed, was forced through the lattice work of the lift. At the time of the accident the lift was only half full. Defendants intimated that they would apply for a new trial.

THE ENGINEERING EXHIBITION AT OLYMPIA.

(*Continued from page 585.*)

Mr. Robt. W. Paul, New Southgate, London, N.—The apparatus exhibited consists almost entirely of pyrometers and temperature-measuring apparatus. Outfits are shown suitable for all ranges of temperature, for portable use and for permanent installations. Thermo-couples, both base metal and platinum, are being shown suitable for hardening, case-hardening and annealing furnaces, &c. The Rhodio thermo-couples should be particularly mentioned, as in these the use of pure platinum is eliminated, with the result that no contamination, and therefore no error, occurs due to protracted use of the instruments.

The indicator used with these thermo-couples has its moving coil mounted on a single pivot, the latter being fixed at the centre of gravity of the moving system, on the well-known Unipivot principle. Fig. 5, p. 614, is an illustration of the portable type.

In the case of the resistance pyrometers, the chief feature of interest is the Harris patent indicator, constructed with a differential galvanometer having an electrical control. A small current (obtained from an accumulator or from the supply mains) works the instrument, and the deflection of the pointer at once indicates the temperature. It is claimed that this is the only direct-reading instrument yet placed on the market which requires no manipulation, and which is independent of battery voltage.

A third type of electrical pyrometer is also being shown, called the "Cone Radiation Pyrometer." In this device, the heat rays emanating from a furnace or hot body enter a tube and are concentrated by a reflecting cone on a small thermo-couple fixed at the inner end of the tube. The thermal E.M.F. thus generated in the small thermo-couple is sufficient to deflect a Unipivot indicator, the temperature being read off on the latter instrument. No focusing is necessary, and the time taken to obtain a deflection is from 10 to

15 seconds. No part of the pyrometer is subjected to high temperatures, and hence the deterioration is nil

A few electrical instruments are also shown on this stand,

Fig. 5.—Paul Portable Thermo-Couple Indicator.

amongst them being Paul's Universal testing set—in effect a portable test-room, and useful for reading voltages, currents, and insulation resistances—the Harris "Omega" insulation testing set, &c.

Foster Instrument Co., Letchworth, Herts.—The exhibits at this stand are mainly connected with pyrometry, and include the well-known fixed-focus radiation pyrometer, which enables the temperature of a furnace to be measured by simply pointing the

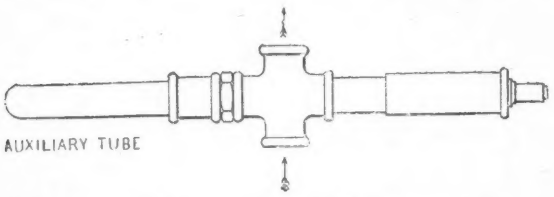


Fig. 6.—Foster Fixed-focus Pyrometer with Cross-ventilating Device.

receiving tube at the hot body with one hand, and reading the indicator held in the other hand. The distance of the tube from the aperture through which the hot body is viewed is immaterial, provided that an upper limit, depending upon the diameter of the aperture, is not exceeded. It is necessary that the hot body shall have a fairly large surface, such as the internal wall of a furnace. Where this method is inapplicable, a similar device can be used

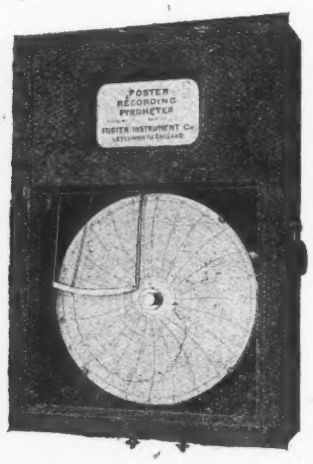


Fig. 7.—Foster Recording Pyrometer.

with a closed end of refractory material, which can be inserted in the furnace, and then acts as the radiating body. Fig. 6 shows the apparatus in outline, with a cross-ventilating device, which forms the latest improvement, and enables a current of air to be passed across the interior of the tube, preventing hot gases from reaching the thermoelectric couple.

Either this apparatus or the Hoskins nickel-chromium thermo-couple can be used in conjunction with a recorder, illustrated in fig. 7. The chart is circular, this form having the advantages that the whole of the record can be seen at once, and it is easy to replace; the pen is a capillary tube kept moist by an inking pad, which, at intervals of one minute (or less if desired), presses the pen against the chart and marks a dot. The record is waterproof, and cannot be smudged.

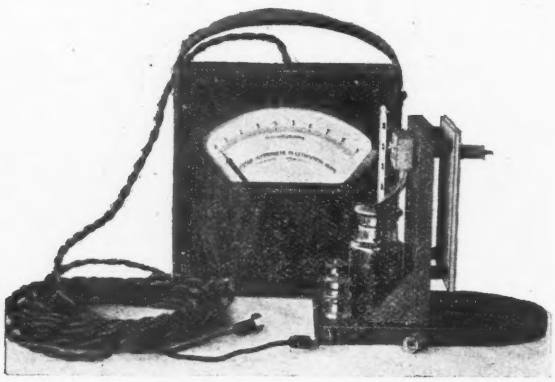


Fig. 8.—Foster Recalescent Outfit.

Another interesting item is a convenient little apparatus for determining the recalescent temperature of steel, which is now so important in connection with the hardening of tools. This consists of a nickel-chromium couple which is covered by a small sample of the steel, an oil-bath for the cold junction, and a portable indicator (fig. 8). The last is set to the temperature of the cold junction, after which the steel is heated to a high temperature with a Bunsen burner, and as it cools the pointer of the instrument continuously indicates the temperature of the sample, showing unmistakably the point of recalescence.

It is interesting to note that the nickel-chromium alloy used for the couples, being highly refractory and little oxidisable, makes excellent triangles for supporting crucibles over a flame, and other useful laboratory accessories. It has the additional advantage, when used in thermoelectric couples, that, unlike platinum, it is unaffected by the presence of emanations from white-hot iron.

The Power Plant Co., Ltd., West Drayton, Middlesex.—This firm has a fine show of double-helical spur gears, bevel gears and racks, which bears striking testimony to the rapid progress made by this type of gearing in popular esteem. Special attention is drawn to the D.H. gears with staggered teeth produced by this firm's patent hobbing process, for which extreme accuracy is claimed; gears produced by the end-milling process are also shown, for the first time by an English firm. Continuous tooth gears of the triple helical type form an interesting feature of the exhibit; but the chief part of the display consists of a long range of self-contained totally-enclosed speed-reducing and raising gears, from a

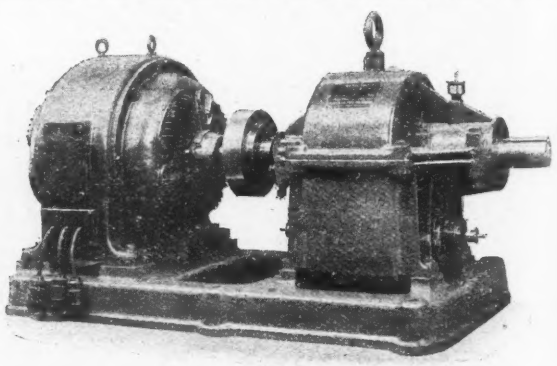


Fig. 9.—Motor with Double-Reduction Gear.

small size, adapted for electrical organ blowing, to a set for transmitting 300 H.P., with a ratio of 5 to 1, for driving a large factory. All ratios up to 15 to 1 are obtained by a single train of D.H. gears; for higher ratios up to 80 to 1 double reduction is employed. A set designed to transmit 24 H.P., increasing from 475 to 3,000 R.P.M., is shown in operation at speeds up to about 5,000 R.P.M., running quietly and without vibration. Similar gears are made by the company for use in connection with steam turbines, turbine pumps and blowers. In the case of the 300-H.P. gear the makers guarantee an overall efficiency of 96 to 97 per cent. A series of flexible couplings, mainly employing leather rings for the elastic connection, is shown, as well as heavier types with the flexible medium in compression. These couplings have no external projections, so that they are free from danger to workmen.

We illustrate in fig. 9 a motor provided with standard double-

reduction gear, the construction of which is indicated in fig. 10. It will be seen that the low-speed shaft is in line with the high-speed shaft, and the whole is neatly enclosed. The high-speed pinion and the low-speed wheel are overhung, and the bearings are specially

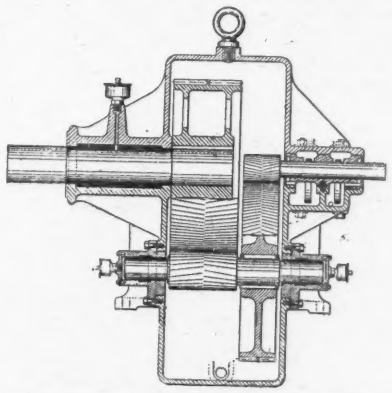


FIG. 10.—SECTION THROUGH GEAR-BOX

long on this account. In the larger sizes, the shaft carrying the former is extended and supported in the low-speed shaft. This gear is designed as a substitute for worm gear, and up to 60 : 1 the efficiency at full load is not less than 90 per cent.

THE HUDSON ECONOMISER CO. (1907), LTD., 110, Bishopsgate Street, E.C.—On this stand are exhibited two working models of water cooling towers made under Brown's patent—one of the open type, the other of the chimney type. The special feature of these is the arrangement of the grids; the water overflows from the troughs and drips on to staggered wooden strips, of which three go

FIG. 11.—CROSS-SECTION OF BROWN COOLER BAR.

to form a hurdle, which can be removed independently of the rest. The drops of water fall on to a flat horizontal surface A, fig. 11, which breaks them up, and each strip is bevelled below to a sharp edge, from which the water drips on to the centre of the strip below. The strips are also grooved transversely, to prevent the water from collecting into a thick stream and to ensure its uniform distribution over the whole of the tower. The firm's patent combined feed-water heater and oil separator is also exhibited.

(To be concluded.)

BUSINESS NOTES.

Liquidations.—J. L. MANUFACTURING CO., LTD.—A meeting is to be held at 85, Gresham Street, E.C., on November 13th, to hear an account of the winding up from the liquidator, Mr. W. L. White.

C. & A. MUSKER, LTD., electric lift makers, Liverpool.—Creditors of this company, or of the Receiver of the debenture-holders, who became creditors between November, 1905, and December, 1909, are asked to communicate at once with Mr. H. Derwent Simpson, solicitor, 18, St. Ann Street, Manchester. See our "Official Notice" pages to-day.

With reference to the notice published in our last issue respecting the liquidation of the PEARSON FIRE ALARM, LTD., we are asked to point out that this liquidation was a purely voluntary one, and was necessitated by the amalgamation of the Pearson Fire Alarm, Ltd., with the May-Oatway Fire Appliances, Ltd. Both companies now trade under the name of Associated Fire Alarms, Ltd., the head offices being at Jewin House, Redcross Street, London, E.C.

INSTITUTE OF WIRELESS TELEGRAPHY, LTD.—Creditors must send particulars of debts, &c., to the liquidator (Mr. G. P. Taylor, 36, Spring Gardens, Manchester) by October 31st.

Osram Week.—We have received from the GENERAL ELECTRIC CO., LTD, a large collection of excellently produced shop window posters, transparencies, leaflets, showcards, postcards, and correspondence labels, such as are being used by the large number of contractors and others who have co-operated with them, in their spirited "Osram week" campaign. The company has certainly thrown itself into this huge popular publicity enterprise in a manner calling for congratulation.

For Sale.—The City of Leeds Markets Committee has for disposal 80 Lewes A.C. arc lamps. See our advertisement pages to-day.

Bankruptcy Proceedings.—H. J. SALTER and H. THORPE (trading in co-partnership as Thorpe & Salter, electrical engineers, High Holborn and Eden Grove, Holloway), also HARRY THORPE (separate estate).—October 26th is the last day for the receipt of proofs for dividend. Mr. E. S. Grey, Official Receiver, Bankruptcy Buildings, Carey Street, W.C.

ALBERT EDWARD MARTIN (trading as the Midland Electrical Supply Co.), electrical engineer, 39, Gt. Charles Street, Birmingham.—The public examination of the above-named debtor was held at the Court House, Corporation Street, Birmingham, last week, before Mr. Registrar Lowe. The statement of affairs was given in our issue of October 4th, page 537. In reply to questions, debtor stated that on betting he estimated his losses at £50. He drew out of the business about twice as much as it was making. Asked what justification he had for this, the debtor said he was afraid that he had none. He attributed his failure to want of capital, having to pay interest in respect of borrowed capital and insurance premiums, loss on contracts, and the heavy law costs of suing creditors. The case was concluded.

JOSEPH PERKINS, electrical engineer, Plymouth.—A first and final dividend of 7s. 6d. in the £ is payable on October 28th, at 7, Buckland Terrace, Plymouth.

Business in Russia.—A circular inquiry addressed to the electrical engineering firms in Russia in which German capital is very largely interested, has elicited the information that the course of business in the present year has been very satisfactory. The Government orders which had long been expected have now been allocated, and a very active demand is also experienced from manufacturers in general, whilst the formation of new companies and the technical transformations being undertaken in the heavy trades, are likewise resulting in the placing of large orders with the electrical firms. A further stimulus is expected to be imparted by the proposed conversion of railways to electric traction.

Catalogues and Lists.—MESSRS. ADNIL ELECTRIC CO., LTD., Adnil Building, Artillery Lane, London, E.C.—New pamphlet No. 108 describing their automatic rope-operated lift controllers for D.C. and A.C. motors and giving weights and prices of same; also a price list of their "Autocom" system of single lever interphones.

MESSRS. ENGINEERING AND ARC LAMPS, LTD, Sphere Engineering Works, St. Albans.—Four-page list, giving particulars and prices of the "Culinan" and "White Star" arc lamps, which are largely used for interior lighting in works and shops.

MESSRS. S. WOLF & CO., 115, Southwark Street, London, S.E.—12-page pamphlet, containing some illustrated practical hints for the fitting and care of the "U H" arc ignition magneto. Copies will be forwarded on receipt of a postcard.

MESSRS. BOVING & CO., LTD., 9½, Union Court, Old Broad Street, London, E.C.—36-page pocket pamphlet, containing a selection of interesting illustrations of hydro-electric equipments, pipe lines, &c., supplied and carried out by them. A tabulated list is given of representative plants installed (water turbines, pipe-lines and Victoria turbo-pumps).

MESSRS. UNION ELECTRIC CO., LTD., Park Street, Southwark, London, S.E.—List No. 92 (88 pages), second edition. This is a pocket catalogue of arc lamps, dynamos and motors, switchgear and instruments, in general use for industrial purposes. A great deal of information is compactly set forth, together with prices and illustrations, in four sections, separated by a thumb index.

MESSRS. C. A. PARSONS & CO., Heaton Works, Newcastle-on-Tyne.—28-page brochure (art paper), dealing fully with the Parsons exhaust steam turbine, and giving brief notes and half-tone illustrations of a number of plants of this class supplied to colliery companies, and gold mining and electricity undertakings. A tabular list of installations of exhaust and mixed pressure plants also appears.

MESSRS. W. H. BAILEY & CO., LTD., Albion Works, Salford, Manchester.—Catalogue containing illustrated descriptions and prices of Bailey's "Tell-Tale" recording gauges for pressure and vacuum.

From STOFFEL'S ELECTRIC SWITCH CO., LTD., of 41, Eastcheap, London, E.C., we have received a folder containing drawings and a description of the Weenen patent automatic point and signal control.

THE DOWSING RADIANT HEAT CO., LTD., 105, Great Portland Street, London, W.—New price list of electric radiators for the 1912-13 season. Many attractive designs of luminous, convector, and illuminated convector radiators are shown, also red glow radiators and an illuminated log fire heater. A new departure is shown in the shape of a series of hot-bar radiators.

THE LINOLITE CO., 25, Victoria Street, London, S.W.—A batch of lists relating to "Tubolite," and the Woodhouse steel casing.

WALSALL ELECTRICAL CO., LTD., 57, Bridge Street, Walsall.—Price list of a new line of small portable ammeters and voltmeters, and of small switchboard instruments, both "electromagnetic" and of the moving-coil type.

The Benjamin Electric, Ltd., 117, Victoria Street, London, S.W.—Complete price list and catalogue (80 pages) dealing with the Benjamin wireless clusters and lighting specialities. The list is fully illustrated and shows a number of new fittings, to some of which we refer in our "New Devices" section to-day.

Oil Prices Advance.—The Scottish mineral oil companies have decided to advance the prices of lubricating and fuel oils by 12s. 6d. to 15s. per ton. "Prices show an advance of fully £3 10s. per ton from the lowest point touched during last year's depression."—*Times.*

Trade Announcements. — Mr. W. H. Taylor announces that he has purchased the stock, goodwill, and book debts of the Electrical and Engineering Supplies Co., Ltd., of 36-37, Upper Thames Street, E.C., and will carry on the business as the Electrical and Engineering Supplies Co., at Harold Wood, Essex, and at 77A, Queen Victoria Street, E.C. The new firm will have increased facilities for manufacturing and stocking motors and dynamos, control gear, switches, &c. For the present the telephone number is "6082 Central."

Messrs. Mickelwright, Ltd., manufacturers of electrical apparatus, announce that henceforth all communications should be sent to them at their new address, Well Works, Alperton, Middlesex.

Mr. L. A. Wells, electrical contractor, has removed to larger premises at 6A, Parade, Cantnrbury.

Point Controllers.—Orders for the Collins patent automatic point controllers with patent mercury stuffing box have recently been secured, or executed, by Messrs. Quillian Bros., Salford, as follows:—For Preston, three additional controllers; Newport (order for five controllers); Accrington (repeat order); Sheffield (one machine); Wallasey (three machines).

Advertising in Turkey.—Though it is unlikely that electrical firms will be disposed to enthusiastically pursue energetic advertising schemes in Turkey at this particular moment in the country's history, we mention the following as a criticism (in the *Near East*) that may be worth remembering:—

"Advertising is as necessary to developing and retaining trade in this country as in any other, and yet, with a few solitary exceptions, British manufacturers do insufficient newspaper or poster advertising. Notwithstanding our preponderant share of Turkey's trade, one sees less than one poster in ten of British-made goods, and perhaps even a lesser percentage of advertisements in the local press. It should be remembered that illustrated advertisements appeal more to the Oriental than whole pages of letterpress."

LIGHTING and POWER NOTES.

Abbots Langley.—The P.C. has decided in favour of the Watford U.D.C. having powers to supply current in the rural district, owing to the high price of gas.

Acton.—The difference between the U.D.C. and the Metropolitan Electric Supply Co. (who in 1911 purchased the Council's electricity undertaking by statutory powers) which arose over the claim of the company to the balance of certain unexpended capital taken up by the Council for the purposes of the undertaking, &c., has now been amicably settled, the Council having handed over the balance of capital (£5,710), and in return having received a cheque for £2,710 for payment of loans, interest, &c., for which the company is responsible under the terms of the transfer capital stores; meters purchased out of revenue, and free wiring of installations purchased out of revenue. A friendly arbitration is to settle the amount of rental to be paid the Council in regard to the site of the generating station.

Argentina.—The president of the Banco Francés has sent in his proposal to the Buenos Ayres Municipality for electricity works in the Federal capital. The following are the main points:—Concession to the end of 1957, when all works, plant, &c., erected during the first 15 years, would revert to the Corporation. The capital invested after the first 10 years to be amortised yearly at the rate of 3½ per cent. Tariffs are specified for private houses and offices, public lighting, municipal offices, hospitals, &c., heating and power. The General Electric Co., of New York, are the technical advisers to the syndicate, represented by the French Bank.

The Municipal Council of the city of Buenos Ayres has approved in general the *ad referendum* contract entered into by the Mayor with the Italo-Argentina Electric Light Co., for establishing works in the Federal capital, and it is expected that the project will be definitely approved. The rapidity with which this project has been dealt with by the Corporation, says the *Review of the River Plate*, has called for considerable comment in the daily Press, which desires to know why the other two projects presented could not have been dealt with at the same time.

Australia.—The report of the Sydney municipal electricity department for the year ending December last shows an output of 17,768,210 units as against 14,398,918 units in the previous year. For power over eight million units were sold, and for public lighting 1¾ million units. The gross profit on the undertaking was £77,265, as compared with £56,236 in 1910, and the net profit £54,010. From this £24,504 was contributed to "depreciation reserve," being 3 per cent. on £816,790, the amount of capital expended at June 30th, 1911, and the balance with other items, amounting to £29,710, is carried forward to next year. The department appears to have set aside for sinking fund and reserve some £150,000 in addition.

The announcement recently made by the Melbourne City Council of its intention to seek enlarged powers in order to supply electric light fittings to consumers on the plea that private firms charge too much, has elicited a protest from the Electrical Traders' and Contractors' Association, a deputation from which has discussed the matter with the Electric Supply Committee of the Council.

The North Sydney Council has appointed Mr. G. A. Julius as the consulting engineer to the proposal to install electric light within municipality and also for the erection of a destructor. The applications from firms and corporations willing to carry out the scheme have been submitted to him for consideration and report to the Council. There were six applications, including one from the Sydney City Council and the Public Works Department.

The Municipality of Parramatta (N.S.W.) proposes installing electric light, and applications are being received for the erection of a generating plant and installation for the supply of electricity for public street lighting and private consumption.—*Australian Mining Standard.*

Ayr.—The Corporation electrical engineer reports that, during the past year, 1¾ million units were generated, being a decrease of 1·4 per cent. from the previous year. The capital expenditure to date is £104,824. The revenue for the year was £13,133—a decrease of £1,017 compared with the previous year, and the net surplus on the year's working was £996.

Barnes.—At a recent meeting of the Council a motion to refer back the decision of the Electricity Committee to take no action in the matter of purchasing 50 electric irons, for lending to approved consumers for the purpose of demonstrating the adaptability of the electric service, was passed.

Bromley (Kent).—The Electric Light and Power Co., Ltd., has applied to the B. of T. for an order permitting it to supply current in bulk to the West Kent Electric Co., Ltd., and to the Chislehurst Electric Supply Co., Ltd.

Canada.—The E. B. Eddy Co., of Hull (on the opposite, Quebec, side of the Ottawa River from Ottawa) has under construction a hydroelectric power plant, which, when completed, will be one of the largest self-owned industrial power plants in the world. The Eddy Co. claims to be the largest wood manufacturing concern in the world.

The supply rates for the city of Winnipeg have been reduced. The matter has been pending since the opening of the new civic power plant. The rates fixed are 3½ cents per KW.-hour for light, with a 10 per cent. discount for cash, which places the light at less than 3 cents (1½d.) per unit. Up to a recent date the Winnipeg Electric Railway Co. had been charging the householders 10 cents per KW.-hour. Power rates, fixed by the city, range from ¼ cent to 1½ cents per KW.-hour. These prices work out on a basis of cost so far below that which obtained heretofore that the citizens are reported to be highly pleased with their own municipal light and power plant.

Another new power development in the vicinity of Montreal, which will soon be looking to London for money for development work, is the Carillion plant, situated 60 miles up the Ottawa River from Montreal, and about the same distance from Ottawa. Carillion is the terminal point of the Ottawa River Navigation Co.; navigation is interrupted here by the Carillion falls, necessitating canals and locks, and for many years a great deal of power has been going to waste at this point. Estimates of the amount of power vary very greatly, some placing it as high as 150,000 H.P. Mr. Henry Myles, formerly president of the Montreal Board of Trade, is at the head of the company which proposes to develop the falls.

A correspondent says that municipal plants in Canada appear to be flourishing, notwithstanding the fact that they have cut the old prices charged by the private companies not only in two, but in some cases, like Winnipeg, in three. The Regina plant will have a surplus this year, 1912, of $70,000, exceeding the early estimates by $28,000.

Peterboro, Ont., has passed a by-law authorising the city to install a hydroelectric power plant to cost $88,000.

Cannock. — At the request of the Wolverhampton Corporation, the R.D.C. has given its consent to the granting to the Corporation by the B. of T., under the provisions of the Electric Lighting Acts, 1882 to 1902, of a provisional order authorising the supply of electricity within an area comprising the parish of Bushbury. The Council has also decided to waive its rights to receive the notice required by the Electric Lighting Act, 1882, to be given to a local authority on or before the 1st day of July.

Chatham.—The T.C. on October 9th accepted a lighting scheme for High Street submitted by the Kent Electric Power Co. as under:—Lighting with 23 600-C.P. metallic-filament lamps, 11 to be extinguished at midnight, £450 per annum; capital expenditure for fixing, £357, less value of lamp columns (£101 10s.).

Cheltenham.—The T.C. has decided to reduce to 1d. per unit the charge for current for power, except for supplies wholly or mainly required during the time of the peak load.

Colchester.—In view of the increased cost of coal, the T.C. has reduced the discount allowed to consumers of current for lighting from 5 per cent. to 2½ per cent.

Continental Notes.—Belgium.—With the title La Société Force Eclairage et Docks de Gand, a company has just been formed in Ghent, with a capital of £160,000, to erect a large coke-making establishment with by-product recovery plant, an electricity generating station in which part of the waste gases will be utilised, and for the working of a new dock at the port of Ghent.

Sweden.—The Storfors Brucks Co. are about to establish a large electricity generating station at Lillfors, in connection with their iron works at Storfors.

France.—The sixth power station on the picturesque Roya River, in the Alps Maritimes, built within the past 10 years, is now under construction at Fontan by the Société des Grands Travaux de Marseilles for the Société Energie Electrique. The building of a seventh power station will, it is stated, be undertaken without delay.—*L'Industrie Electrique.*

Russia.—The Rouchials waterfall, on the river Vuoksa, in Finland, has been acquired for the purpose of developing electric power. The fall will develop 48,000 H.P.

Devonport.—A disorderly scene occurred at the B.C. meeting on the 10th inst. in regard to the discharge of a fitter from the Corporation electricity works. An explanation was given by the engineer (Mr. Spark) that the step was necessary in order to maintain discipline and good order at the works.

Dudley.—A request having been made to the B. of T. for a public inquiry in reference to the sale by the Corporation of the electrical undertaking, a reply has been received from the Board stating that the Corporation is empowered, subject to the conditions specified in Sec. 69 of the Electric Lighting Order, to transfer by deed its undertaking to a company at any time. No deed has, however, been submitted as yet to the Board, who, on receipt of the same, will consider fully the representations that have been made.

A meeting of members and friends of the Dudley Traders' Association was held last week under the chairmanship of Mr. A. E. Longmore, at which Councillor Tanfield delivered an address in reference to the sale. He said that he had taken the advice of a consulting engineer who inspected the works. His engineering friend had assured him that £5,000 would put the plant into a condition sufficient to carry on satisfactorily for the next few years. Mr. George Conaty, consulting engineer, Birmingham, also spoke. He compared the Dudley works with those of 24 similar towns, and argued, therefrom, that there was no reason for the Corporation to rush to a sale.

Dundee.—The concrete piling and foundations for the Dock Street sub-station, situated near the entrance of the Harbour, were completed last week, and building operations are being carried on as fast as possible ; a sub-station is also being erected in Larch Street.

East Kent.—The South-East Kent Electric Power Co., Ltd., has applied to the B. of T. for permission to erect overhead lines from Tilmanstone Colliery to Eythorne and district in the new colliery area, for the transmission of current at a pressure of 11,000 volts.

Hendon.—The North Metropolitan Electric Supply Co. has applied to the R.D.C. for permission to supply current within the Council's area.

Hereford.—The T.C. has received from the L.G.B. sanction to a loan of £1,000 for services, repayable within 25 years.

Hessle.—The U.D.C. has decided to negotiate with the Hull T.C. and such companies or firms as thought fit, with the object of putting the E.L. Order into force on the best possible terms for the ratepayers.

Hove.—After a lengthy discussion on October 10th, the T.C. deferred for further consideration by members the recommendation (mentioned in the last issue of the Electrical Review) to give the E.L. company notice of the Council's intention to exercise its right to purchase the undertaking.

Hitchin.—The U.D.C. has decided to light the waterworks' engine house by means of a small independent plant at an estimated cost of £43. Gas has cost £16 a year, and electricity will save about £7 per annum.

Japan.—The Tone Hydraulic Electric Power Co. is reported to be in negotiation with reference to the establishment of electricity generating stations at Yoshimok and at a point on the upper reaches of the River Tone. It is stated that the plants to be put down will have a total capacity of 100,000 H.P.

Kendal.—The T.C. has applied to the L.G.B. for a loan of £1,000 for cables (£800), services and meters.

Kingstown.—The question of the electric lighting of Kingstown, Dalkey and Blackrock came before the Kingstown Urban Council on Monday, and an animated discussion followed. Mr. E. H. Andrews, vice-chairman, moved the adoption of the report furnished by the Roads Committee. He said there was a widely-expressed desire for the undertaking, especially amongst the traders. He was confident that the proposed company could be floated, and that the Council's interests would not suffer. If the proposal were frustrated the scheme would be delayed for a number of years. Mr. Evans explained the scheme ; the company intended to erect a central generating station for Kingstown, for which it had been offered a suitable site at Glasthule In the station it would install alternators driven direct by high-speed internal-combustion engines, which would supply three-phase alternating current to sub-stations or transformers in Kingstown, Blackrock and Dalkey, and it would be possible to light all shops and houses on the tram line from Dalkey to Blackrock. In addition, it was proposed concurrently to lay 4 miles of low-tension mains along streets and roads. The scheme would at the start light over 7 miles of streets and roads. At the commencement the charge for the light would be 4½d. per unit, and for power 1½d. per unit, and it was hoped in the near future to be able to make a reduction in these charges. The scheme would bring additional work and money into the township and would roughly cost £25,000, the major portion of which would be spent in Kingstown. Mr. Croskerry said that there were three ways in which the company could carry out the undertaking — first, by Act of Parliament ; secondly, by provisional order ; and thirdly, by the consent of the three Councils to the opening up of the roads, and the laying of the mains. It was intended to adopt the third of these alternatives, and thus avoid the very heavy tax which the cost of obtaining Parliamentary powers would put upon the capital of the company. The latter, while not looking for the street lighting, would be prepared, if necessary, to light, clean, and maintain all arc lamps of 1,000 C.P. which the Council might place on any of the streets or roads through which the company's main lines were laid, or within 75 ft. of any high-tension or low-tension main, at the rate of £16 per annum for lamps burning 1,500 hours, or, in the alternative, to supply the Council with current for lighting purposes at cost price, namely, at 2½d. per unit, and to allow the Council to carry out the lighting of the streets itself. It was suggested that, as several members of the Council had financial interests in the proposed company, the matter should be postponed for a month, but after further discussion, the report of the Roads Committee recommending the scheme was adopted.

Ledbury.—Messrs. Brown & Parsons, Ltd., of Leamington, have informed the U.D.C. that they are applying for a prov. order for E.L., and that owing to the absence of these powers they are unable this year to tender for the public lighting, as they had hoped to do.

Llanfairfechan.—A special meeting of the U.D.C. has been held to interview Mr. W. R. Walton, of Manchester, in reference to a lengthy report which he has submitted on the question of lighting the town by electricity. Mr. Walton advises the Council to obtain powers for providing and working such an undertaking, and to immediately make inquiries as to probable consumers in case a supply were available. He estimates the cost of developing water power, building the dam, providing and laying a steel pipe, &c., at about £5,500. If oil engines were used, it would cost about the same. A steam plant would cost £4,900 for the complete installation, and a suction gas plant about £4,650. He estimated the gross net revenue at about £850 per annum. The report was discussed at length with the engineer, and ultimately it was decided that before coming to any decision in the matter, each member be supplied with a copy of the report, and that a further special meeting of the Council be called to consider the matter.

London.—Stepney.—Application is to be made to the L.C.C. for sanction to the borrowing of £2,500 for meters and £2,800 for house services.

Bermondsey.—The Electricity Committee has given instructions for an insurance policy to be taken out against loss of profits through inability to supply consumers owing to the stoppage of supply in the case of fire, at an annual premium of £3. This policy covers £6,000 for three months' period of interruption.

Poplar.—The Electricity Committee has considered a report of the electrical engineer on the subject of low-tension mains. The report points out that the increase in load over last year is quite unprecedented, and that, as the bulk of the increased supply is to consumers on the Isle of Dogs, the number of feeders out of the Millwall sub-station will have to be increased. Owing to the present high value of copper and lead, which would render the cost of the new feeders abnormal, the engineer suggests that the major portion of the work should be carried out with reclaimed dormant cable, at a cost of £1,367, new materials being used for the remaining portion at a cost of £492.

Stoke Newington.—The Public Health Committee reports that it has agreed with the Electric Lighting Committee that, as from March 31st last, the charge to be made against the undertaking in respect of the steam supplied from the refuse destructor for the generation of current shall be at the maximum rate of £1 per 1,000 units for all low-tension units delivered at Edward's Lane station (the minimum charge to be £10 per quarter for water consumed), and the payment of the balance between such minimum and maximum rate to be subject to deduction of the extra cost of the bulk supply consequent upon failure of the steam supply from any cause, each quarter to be calculated separately.

Lossiemouth.—At a special meeting of the T.C. it was agreed to proceed with an electric lighting scheme for the town, various offers having been reported on by Mr. J. A. Bell, of Aberdeen.

Lowestoft.—The T.C. has decided to rent shop premises in High Street at £20 a year for use as a showroom, &c., in connection with the electricity department.

Lytham.—The question of electric lighting which ha excited public interest on many occasions during the past couple of years, has once more come to the front in the decision of the

St. Anne's Urban Council, who already possess a plant, to apply to the Board of Trade for an order to supply current in the Lytham urban district. The Lytham Council, with the support of the tradesmen's and the ratepayers' associations, is also applying for powers to install its own electrical plant, in order to supply electricity for all purposes in its own district; and the rival applications are creating a lively interest in the two towns.

Mansfield.—Some time ago the Mansfield Guardians decided to install the electric light throughout the workhouse, and a committee was appointed to prepare a scheme in order that the L.G.B. might be asked for sanction to a loan. This was done, but it transpired at the last meeting of the Guardians that the lowest tender was £200 in excess of the amount they had obtained sanction for, consequently the committee has been instructed to revise the specification, and to take what steps it deems advisable in the matter.

Midlothian.—The County Council has referred to the General Committee an application by the Colinton Tramways Committee for the consent of the Council to an application to the B. of T. for an order under the Electric Lighting Acts, for an area in the parishes of Colinton and Corstorphine.

New Malden.—After several months' dispute, the final report of the surveyor of the U.D.C. has been accepted in regard to the installation of about 90 lamps in the public offices by a local contractor at a cost of £144, as against a sum of £150 sanctioned by the L.G.B. It appeared that the lowest tender had not been accepted, and that an utterly unfounded allegation had been made as to a business connection between an official of the Council and the contractor. The U.D.C. will shortly consider a scheme for electric street lighting from the mains of the Wimbledon municipal undertaking.

had grown very much in their district, and it now became necessary for them to extend their generating plant, and to get in a modern engine. It was suggested that a Diesel engine should be obtained. It was also necessary, in consequence of the increased plant, to extend the buildings. The electricity department had been very successful, and at the end of the financial year, he believed, would show a profit of about £1,500. The Committee which went into the matter recommended the Council to apply to the L.G.B. for the loan of £9,000, and this was agreed on.

Port Glasgow.—The protracted negotiations between Port Glasgow and Greenock Corporations regarding the supply of electricity to shipbuilders seem at last to have resulted in bringing about a settlement. At a private meeting of the Port Glasgow T.C. it was resolved to enter into an agreement with Greenock Corporation whereby Port Glasgow will apply during the present session of Parliament for an electric lighting order, authorising it to supply electrical energy for all purposes within the burgh of Port Glasgow. It will ask for power to transfer the order to the Greenock Corporation within 12 months, Greenock to undertake to accept such a transfer. Greenock, it is stated, is to undertake to immediately distribute current for all purposes within the burgh of Port Glasgow, and to bear the whole expense of the order and the deed of transfer.

Scarborough.—The Electric Supply Co. has been holding a series of exhibitions in cooking by electricity at the Albert Hall.

Skelton and Brotton.—The U.D.C. has, by 14 votes to 3, decided to apply to the B. of T. for a prov. order for E.L. A report on the question has been prepared by Messrs. May and Hawes, of London.

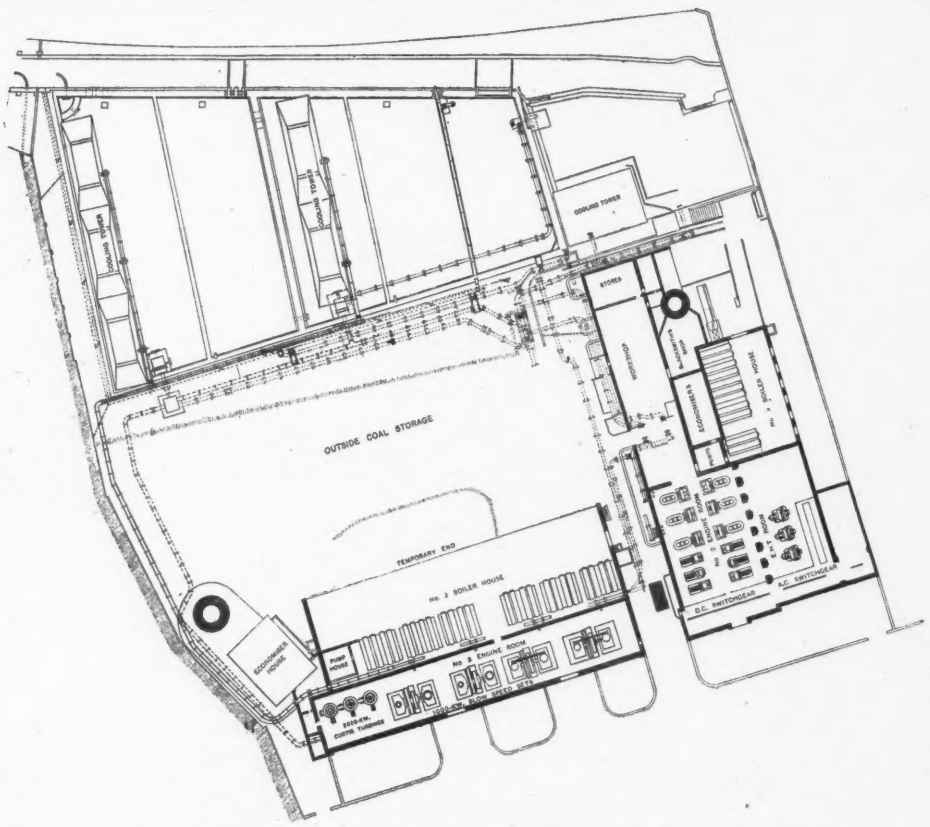


Fig. 1.—Plan of the Valley Road Electricity Works of the Bradford Corporation.

Newport (Mon.).—The T.C. has applied to the L.G.B. for a loan of £3,220 for electricity purposes.

Northfleet.—Mr. E. Castle has applied to the Gravesend T.C. for a supply of current for new cement works he is constructing at Northfleet. The Council desires guarantees for the payment of not less than £500 per annum for a period of five years, with further guarantees for adequate compensation in respect of mains rendered unproductive by the discontinuance of the works.

Nuneaton.—The R.D.C. has consented to an application by the Leicestershire and Warwickshire Electric Supply and Power Co. for the erection of overhead transmission lines in the district.

Pembroke (Dublin).—At a meeting of the Council, the Roads Committee recommended the Council to press on matters connected with the proposed loan of £9,000 for electric lighting improvements. The chairman said that the demand for electricity

Sligo.—The B. of G., after considering tenders and examining the scheme of the engineer in connection with the proposed electric lighting of the town, and also hearing the observations of a representative of Messrs. Parte, has abandoned the proposal for the electric lighting of the workhouse. It appeared, during the discussion, that several members of the Board were shareholders of the Sligo Gas Co., and in the course of a noisy debate, allegations were made that the place would be "blown up" if electricity were used, and that local carters would lose their jobs in carrying coal to the gas works. On the other hand, Ald. Jinks is reported in the *Sligo Times* to have remarked: "It is an awful thing to get up here and speak against the gas company."

Application is to be made by the Corporation to the B. of T. for a provisional order authorising the adoption of an electric lighting scheme for the town.

Swindon.—The T.C. has received the sanction of the L.B.G. to a loan of £6,500 for electricity purposes.

(*Continued on page* 623.)

ELECTRICITY SUPPLY DEVELOPMENTS AT BRADFORD.

Last week as briefly recorded in our pages, the official ceremony of starting the third Curtis turbo-generator, recently installed at the Corporation electricity works, took place.

This development provides another landmark in the history of one of our most enterprising municipal electricity supply undertakings—that history, as our readers are aware, having been closely followed in our own pages.*

The original generating station (No. 1) at Bolton Road, opened in 1889, has long since been relinquished to other uses, while at the second, or No. 2 station, at Valley Road, which was opened in 1897, some equally striking changes have occurred; the boiler house there, with its marine boiler and induced-draught equipment has been transformed into a well-lighted and equipped rotary sub-station or "H.T. annexe," which also houses the extra-H.T. alternating switchgear for the three-phase plant installed in the two Valley Road stations.

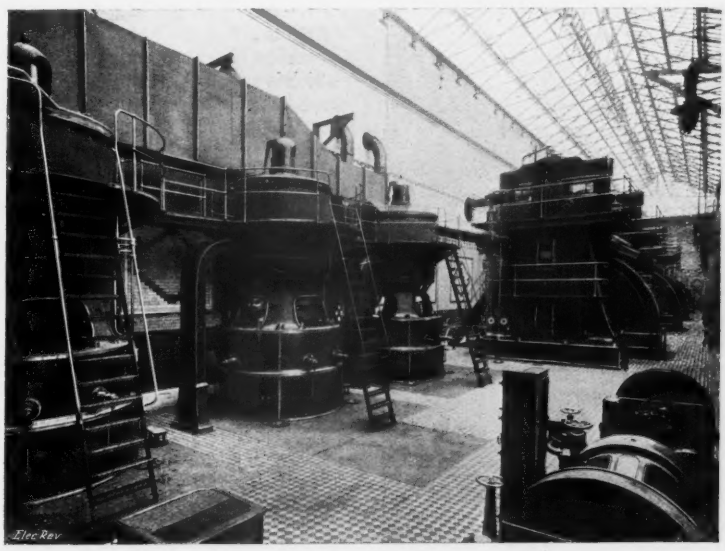


Fig. 2.—Interior of the Valley Road No. 3 Station, Showing the Turbine and Reciprocating Engine Plant.

As regards the No. 3 station, it now contains 14,500 KW. of generating plant, including four slow-speed cross-compound vertical Corliss engines of 1,600 I.H.P. each, by Cole, Marchant and Morley, and Musgrave & Sons, coupled to 1,000-KW. Westinghouse direct-current generators and three B.T.-H.-Curtis vertical turbo-alternators, each of 3,000 KW. (5,000 H.P.) nominal capacity. The latter sets are in most striking contrast to the former, both in regard to floor space taken up, viz., 57 sq. ft. for the turbine, as against 683 sq. ft. for the reciprocating set, and steam consumption per unit generated, *i.e.*, 16 lb., as compared to 20 lb.

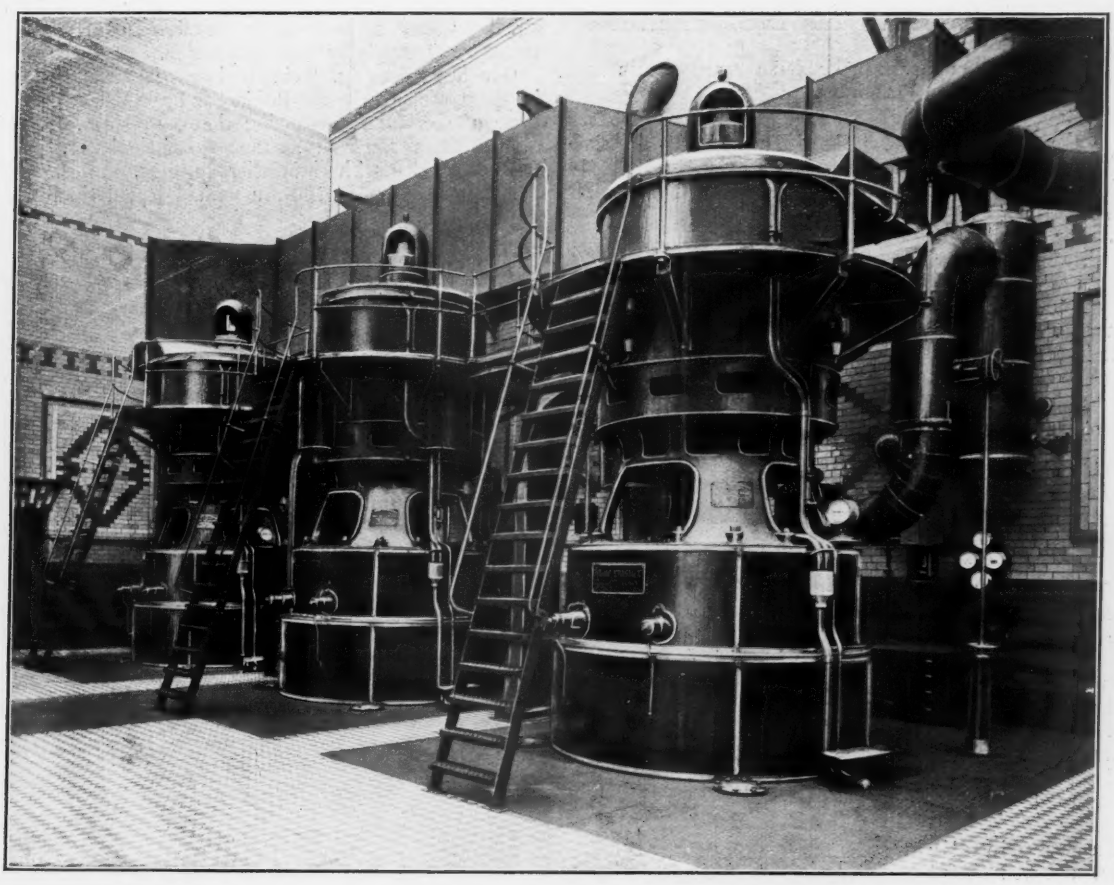


Fig. 3.—Curtis Turbine Plant at the Valley Road No. 3 Station, Bradford.

The new turbine set which we illustrate in fig. 3 with

* Elec. Rev., June 10th, 1892, original installation at Bolton Road No. 1 station; November 26th, 1897, Valley Road No. 2 station; December 18th and 25th, 1903, Valley Road Nos. 2 and 3 stations.

the two previous ones, has been designed to give 4,500 KW. continuously (5,000 K.V.A. at ·9 power factor) at 6,600 volts, three-phase, 50 cycles, when running at 1,500 R.P.M.

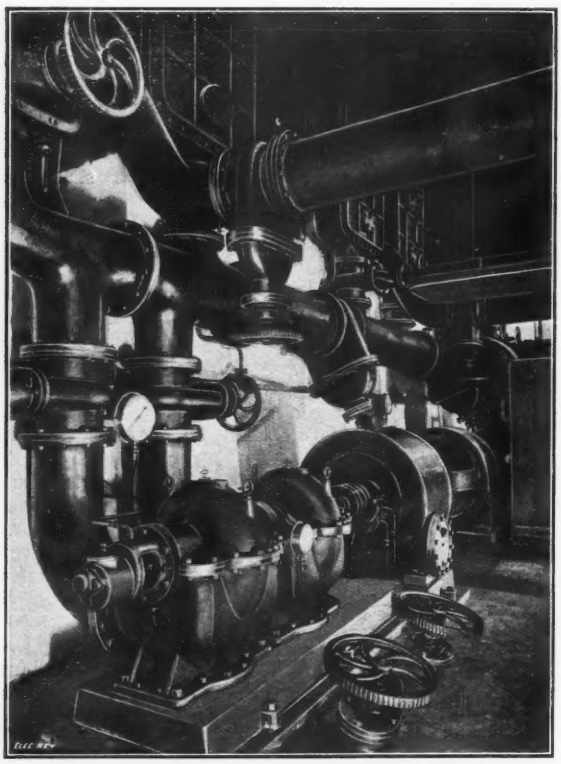


FIG. 4.—TURBINE-DRIVEN CIRCULATING PLANT IN THE BASEMENT.

It is the largest vertical turbo-alternator built in the United Kingdom. The two previous sets were designed each to carry 3,000 KW. continuously, and with an overload capacity of 4,500 KW. for a limited period, while the new one is designed to carry 4,500 KW. continuously.

It is mounted similarly to the earlier sets on a sub-base condenser, and the turbine is as nearly as possible similar to the previous ones, the generator rotors being interchangeable.

When developing 3,750 K.V.A. at 6,600 volts, the temperature rise above the surrounding air of any part of the alternator will not exceed 40° C., and at 5,000 K.V.A., and ·9 power factor, it will not exceed 50° C., measured by thermometer.

An exceptionally large and well-lighted basement, some 18 ft. in height, contains the whole of the condenser auxiliary plant for the three turbines, the sub-base condensers being of the Worthington type.

The new condenser when supplied with cooling water at 80° F. and dealing with 70,200 lb. of steam per hour will maintain a 27-in. vacuum. When dealing with 60,000 lb. of steam per hour it will maintain a $27\frac{1}{2}$-in. vacuum; and when dealing with 49,500 lb. of steam per hour it will maintain a $27\frac{3}{4}$-in. vacuum. The cooling surface of the sub-base condenser is 8,200 sq. ft.

The circulating pump is of the twin type, capable of delivering 8,000 gallons of water per minute against a head of 60 ft., and is separately driven by a 200-B.H.P. Curtis steam turbine running at 1,700 R.P.M., shown in fig. 4, which is supplied with steam at 180 lb. pressure and 100° F. superheat. The auxiliary turbine exhausts into a feed water heater, the back pressure of which will not exceed 20 lb. per sq. in. absolute.

This method of driving auxiliaries by small steam turbines is becoming popular, owing to the convenience in starting up the plant and the small space occupied where usually little space is available, and where the exhaust steam from the smaller turbine can be conveniently used in a feed water heater, the efficiency of this arrangement nearly approaches the ideal.

The main turbine speed can be varied from the switchboard at will during the process of synchronising by means of electrical gear and a motor operating upon the governor gear of the turbine.

The air required for ventilating the three turbo-alternators is drawn through a B.T.-H. air filter consisting of 42 removable box sections, each fitted with special filter cloth. These filter sections are supported in a suitable framework, and are individually removable for the purpose of cleaning—two spare sections being provided for this purpose.

The filtered air is passed along through the overhead ducts (shown in fig. 3) to the alternators.

The air filter is capable of dealing with 60,000 cb. ft. of air per minute.

No separate blower fans are provided for circulating the air, the alternator rotors being so designed as to propel the necessary air supply by their own action.

Our illustration, fig. 2, clearly shows the great difference in space occupied by the turbine and vertical engine sets, three of the former occupying the same space, but with over 10 times greater output than one of the latter.

In connection with the earlier turbines, the circulating pumps were driven by 130-H.P. variable speed shunt-wound

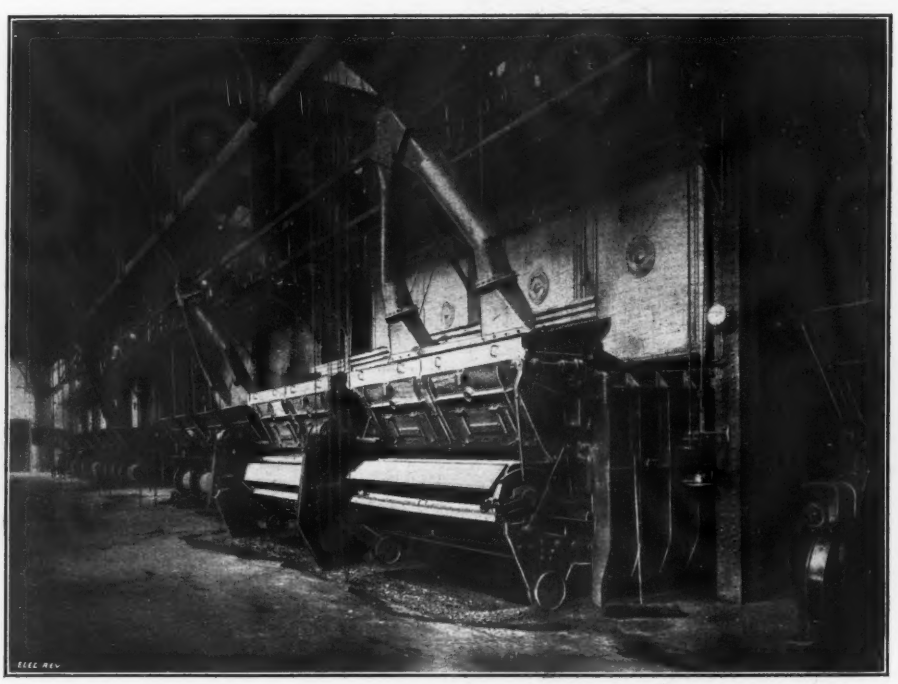


FIG. 5.—THE BOILER HOUSE, NO. 3 STATION; NEW TYPE OF CHAIN GRATE IN FOREGROUND.

motors, controlled through Brook-Hirst switch pillars; the three circulating plants, however, together with two Allen steam-driven circulating pumps in the adjoining station

supply the whole of the condensing water requirements of both the Nos. 2 and 3 stations, the former of which contains some 6,000 H.P. of Willans engines.

Each of the turbine units is provided with a three-throw air pump, gear-driven from a 25-H.P. motor, and duplicate motor-driven three-throw pumps working in conjunction with an accumulator, are installed for the pressure water supply to the turbine footstep bearings.

The boiler house which we illustrate in fig. 5, contains 10 Babcock boilers, each with an evaporative capacity of 18,000 lb. of steam per hour, also two larger boilers by the same makers, each of 25,000 lb. evaporative capacity; these supply steam at 180 lb. pressure, superheated 200° F.

All the boilers are equipped with chain grate stokers, the two latest ones, shown in the foreground in fig. 5, being of the most modern type, having only one wide grate per boiler.

The wide grate is supposed to allow of the use of smaller fuel and is more easily repaired in case of breakage to a link.

In connection with these boilers are overhead coal bunkers of 3,000 tons capacity, feeding the stokers through Avery travelling weighing machines and spouts; also coal and ash-conveying plant, two large economisers and four 10,000-gallon per hour Hall feed pumps.

An interesting little motor-driven apparatus, which has proved very effective in use, is the Hamler Eddy smoke recorder, in the economiser house; this device pumps small quantities of smoke from the chimney, through a fine nozzle on to a recording chart, giving a smoke line of approximately the same density as the chimney discharge, which is examined daily and duly respected by the boiler house staff; another device which has proved very useful, is the Kentometer installed in connection with the turbo-condensers, and which gives directly the percentage of perfect vacuum without reference to the barometric reading.

For operating purposes the works just described are coupled both on the steam and electrical sides to the adjoining No. 2 station, where, indeed, the whole of the extra-H.T. three-phase and direct-current switchgear is installed.

In the latter works the original 12 Willans sets still do service on the peak and for balancing purposes, although one might hazard a guess that in view of the No. 3 engine

Fig. 6.—Direct-Current Remote Control Board at the No. 2 Valley Road Works.

room being now full of plant, their days are probably numbered.

This station also contains a boiler house with five Babcock units, each of 14,000 lb. evaporative capacity—now used only during the winter months—with economiser, feed-pumps, &c., and condensing plant.

The whole of the condensing plant at both stations is

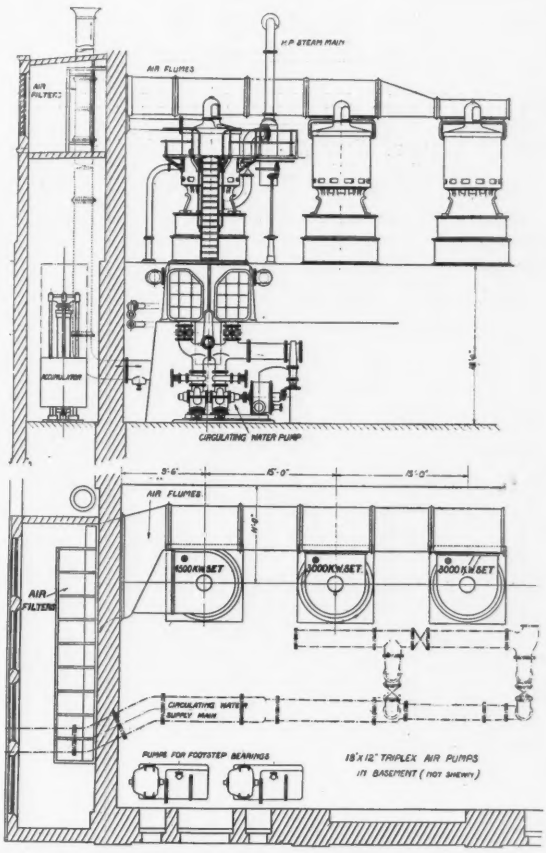


Fig. 7.—Showing the Arrangement of the Curtis Turbine Plant.

coupled by means of a ring circulating system to three cooling towers, one large Davenport tower with three chimneys, of 365,000 gallons per hour capacity, one by the same maker of 243,000 gallons per hour capacity, and an older Klein tower of 160,000 gallons capacity. These are mounted over reservoirs having a capacity of 2,250,000 gallons, and the larger ones are shown in fig. 9. In connection with this plant a Lescole distance thermometer and

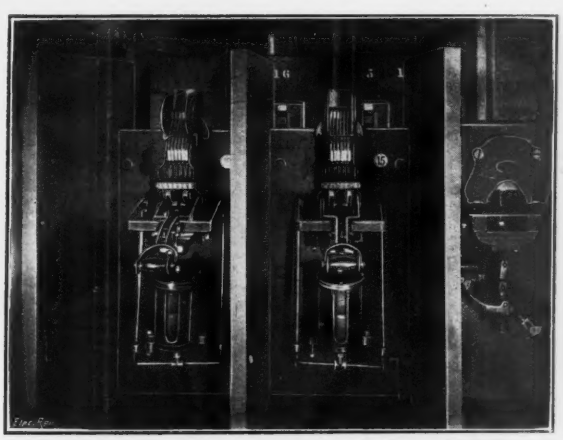


Fig. 8.—1000-kw. Circuit Breakers, Operated from the Board Shown in the Adjoining View.

plug board is provided in the No. 3 engine room, by means of which the temperature of the turbine condenser inlet and outlet, air pump discharge and cooling tower water, and boiler room feed can be instantly obtained. The general lay

out of the two stations is shown in fig. 1, page 618; the large area of land between the cooling tower plant and stations is being used for supplementary coal storage, a reserve of 6,000 tons being aimed at in addition to the bunker capacity in the stations. (*To be continued.*)

A 28,000-H.P. ZOELLY STEAM TURBINE.

Messrs. Escher, Wyss & Co., of Zurich, have recently delivered to the Rheinisch-Westfülischen electric power station in Essen, one of the largest steam turbines contained in one casing that has up to the present time been built. This turbine is designed to develop 22,500 H.P. effective, under normal continuous working, at a speed of 1,000 R.P.M., the initial steam pressure being 150 lb. per sq. in. above the atmosphere and the steam temperature, 572° F. at the stop valve, while the turbine exhausts to a vacuum of 27½ in. In this case only a low vacuum is obtainable, as the temperature of the circulating water for the condensing plant is comparatively high, being re-cooled through a cooling tower. The turbine can develop 28,000 H.P. continuously, and even 30,000 H.P. for short periods.

The design is of the usual "Zoelly" type, to which Messrs. Escher, Wyss & Co. have already constructed well over 225 machines, with a total of approximately 500,000 H.P. The turbine rotor consists of 14 runner wheels, and the total weight of the rotor, including shaft, is 26 tons. The generator rotor, which is of the Siemens-Schuckert type, is connected to the turbine shaft by means of a rigid coupling, and weighs 60 tons. The generator and turbine rotors are supported by four bearings which are lubricated with about 130 gallons of oil per minute, under pressure. When starting up the turbine, the oil pressure is obtained by a small steam turbine-driven centrifugal oil-pump, and as soon as the turbine has attained its normal speed, a cogged-wheel pump, driven from the main shaft, produces the desired pressure and the centrifugal pump is then shut down. The oil flows from the bearings to an oil tank contained in the bed-plate of the turbine, where it is cooled by means of water coils; it is then pumped back to the bearings by the cogged-wheel pump, and continues the cycle thus described. Only a very small quantity of oil is required from time to time to make up for waste.

The exhaust steam is led through a pipe 3 ft. in diameter to the surface condensing plant situated in the basement of the power house and immediately below the turbine, the circulating water being supplied from a cooling tower. A separate pump delivers the condensed steam into a tank, from whence the boilers are fed by means of feed pumps.

This large turbine, owing to its simple design, requires little more attendance than much smaller units.

Our view shows the turbine during construction in the shops of Messrs. Escher, Wyss & Co., at Zurich.

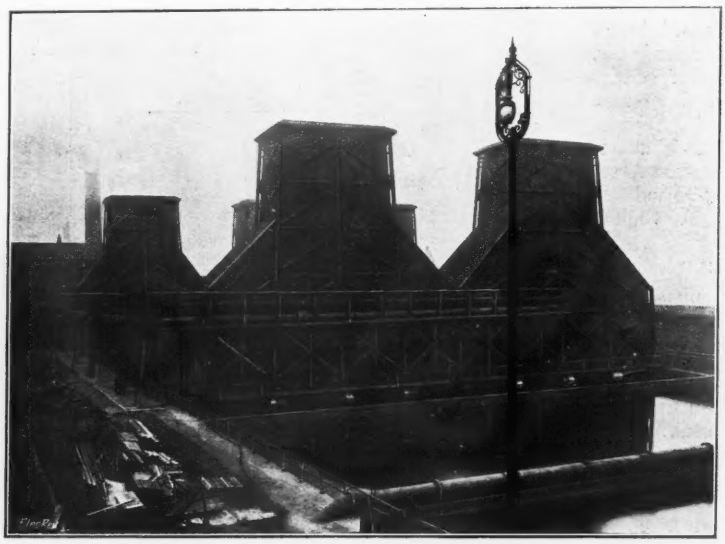
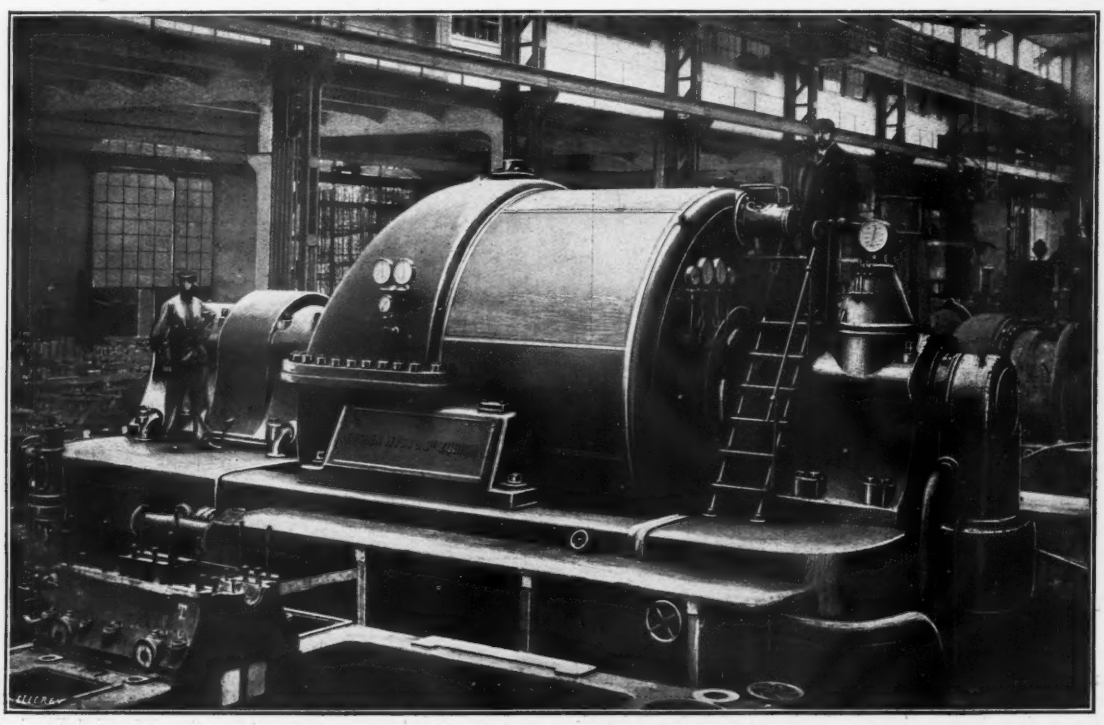


Fig. 9.—Davenport Cooling Towers at the Bradford Electricity Works
(See previous page).



28,000-H.P. Zoelly Steam Turbine for the Essen Electricity Works.

LIGHTING and POWER NOTES.

(*Continued from page* 618.)

U.S.A.—The longest transmission line so far known is under construction from Los Angeles, California, to Big Creek, a distance of 248 miles. Power is to be conveyed at a pressure of 150,000 to 175,000 volts.

Uruguay.—It is reported from Monte Video that as soon as the Electric Monopoly Bill receives the sanction of the Senate, it is the intention of the Government to erect State power houses in 15 towns immediately. These are La Paz, Las Piedras, Pardo, Punta del Este, Maldonado, San Carlos, Santa Lucia, Canelones, Rosario, Dolores, Nico Perez, Sarandi del Yi, Treinta y Tres, San Fructuoso and San Eugenio. The installation of these services is estimated at from $25,000 to $30,000 gold each, and tenders will shortly be call for them.—*Review of the River Plate.*

Walsall.—Sanction has been received from the L.B.G. to the borrowing of £9,000 in respect of capital expenditure for the undertaking.

Warrington.—The annual statement of accounts shows that the gross profit on the electricity undertaking for the year ended March 31st last was £7,709, and the net profit £1,745. After transferring £500 in aid of rates, and £363 as a contribution to capital, the working balance shows a credit of £3,078, while the reserve fund amounts to £9,358. The capital expenditure was £6,558, and the debt repaid £3,859. The loans outstanding amount to £79,046. The quantity of electricity generated was 4,207,932 units, a considerable increase on the preceding year.

Watford.—A loan of £3,685 for additional generating plant has been applied for by the U.D.C.

Whitehaven.—The T.C. has decided to expend £150 on the purchase of "Tricity" cooking outfits, which are to be installed at rentals ranging from 1s. 6d. to 6s. per quarter. The necessary wiring will be done by the Council through local contractors.

TRAMWAY and RAILWAY NOTES.

Argentina.—Messrs. J. G. White & Co., of Buenos Ayres, have sent an expert to San Juan, with the object of reporting upon the possibility of establishing a system of electric tramways in that town and the surrounding district. *The Review of the River Plate* anticipates that the report will be favourable.

Baildon.—Terms have been settled between the Bradford Corporation and the Baildon U.D.C. with regard to the extension of the Bradford tramways from the present terminus at Baildon Bridge, Shipley, to Baildon. A provisional order will have to be applied for by Baildon, and some time will elapse before the extension is made.

Birmingham.—The Tramways Committee hopes to bring forward shortly a recommendation with regard to the provision of better means of communication between the Selly Oak tramway terminus and Northfield. The Committee is of opinion that no railless trolley system at present known can become a substitute for tramways, as it could never adequately deal with large masses of people owing to the size of the vehicles, which can only carry 28 passengers.

Burley-in-Wharfedale.—A special meeting of the U.D.C. has conditionally approved of the proposals of the Leeds Corporation for the introduction of a system of railless cars from the present terminus at Guiseley to Otley, and also through Burley to Ilkley.

Bradford-Halifax. — Negotiations are in progress between the Tramway Committees of the two Corporations with reference to the proposed running of through cars between Bradford and Halifax, and Bradford and Brighouse.

Continental Notes.—Austria.—The State Railway authorities are about to establish a plant to utilise the water power of the River Saalach, near Kibling, for generating the necessary energy for the operation of the Salzburg, Reichenall and Berchtesgaden Railway, which is at present being converted to electric traction. It is estimated that about 2,000 H.P. will be available.

Italy.—An important scheme has been drawn up for the construction of an electric underground railway in Genoa, between Sampierdarena and the Quarti dei Milli. The projected line would be about 6½ miles in length, of which some 4¾ miles would be in tunnel, the maximum gradient being 19 per cent. It is proposed that the line shall be on the continuous-current third-rail system.

The Italian State Railway department has just placed fresh contracts with the Italian Westinghouse Co., of Vado Liguro, for 45 2,000-H.P. and eight 2,600-H.P. locomotives. The capacity of these locomotives aggregates 110,800 H.P., and with the 40 2,000-H.P. already supplied by the same firm, makes a total of 190,000 H.P. three-phase locomotives acquired, or to be acquired, by the Italian State Railways.—*La Lumière Electrique.*

France.—According to the *Temps*, the conversion to electrical driving of the Suburban State Railways around Paris will be completed in 1916. The lines affected will be the Paris (St Lazare)-Auteuil-Champ de Mars (called the Auteuil group); Paris (St. Lazare)-Versailles-Chentiers-Issy branch-Saint Nom la Breteche (Versailles group); Paris (St. Lazare)-St. Germain en Laye (St. Germain en Laye group): Paris (St. Lazare)-Mantes-Pontoise, through Maisons Lafitte and Argenteuil (Argenteuil group); St. Germain-Etat-St. Germain (grand ceinture). Each stretch will be laid with double lines. Motor coaches, equipped with 250-H.P. motors, running at 80 km. an hour, will be employed. The draft of the Budget for 1913 provides a sum of 28,785,000 fr. for constructive works, and 14,910,000 fr. for rolling stock.

A number of petrol-electric motor vehicles, specially designed to act as travelling repair shops in connection with the Aeroplane Corps, have lately been completed by the Brasier Co., of Paris, to the order of the French Military Authorities. The vehicles are fitted with a range of machine tools, which, like the cars themselves, are electrically driven, the motive power for all the motors being supplied by the petrol engine at the front.

The French State Railway Authorities have granted facilities to the Westinghouse Co., of Paris, to make some trials on the railways in the Cote d'Or district, with a new petrol-electric motor train.

Russia.—Two new lines of electric tramway have just been completed in Moscow; it is proposed to construct next year a new line to give communication with the more distant parts of the city.

Germany.—It is reported from Berlin that the Commission which recently visited London, at the instance of the Prussian Ministry of Railways, to inspect and report upon the working of the underground electric railways in the metropolis, has recommended that the London system of train formation and running, and the signalling arrangements, particularly the latter, should be adopted in connection with the electrification of the railways in Berlin and its suburbs.

Switzerland.—Plans are being prepared in respect of a projected electric railway between Le Locle and La Brevine.

Spain.—The electric tramway, which has been under construction for over two years by a Belgian company between San Sebastian and Tolosa, was opened on August 27th, with customary ceremonial. The line is 25 km. long, and has been built in sections, the first section to Andoain having been completed a year ago. The line affords connection between the capital of the Province of Guipuzcoa and the picturesque industrial town of Tolosa, of 12,000 inhabitants. Power is obtained from the hydroelectric station at Andoain, belonging to the Hidroelectrica Iberica.

East Ham.—The Tramways Committee has decided to agree to a suggestion of the Municipal Tramways Association that local authorities owning tramways should refuse to erect any further guard wires, as they are now asked by the G.P.O. Telephone Department to do wherever telephone lines cross trolley wires, pending the result of the Association's negotiations with the P.O. authorities on the matter.

Lancashire and the Motor-'bus. — A correspondent writes that a company is being formed to link up most of the main towns by motor-'bus. It is proposed to have 12 motor-'bus lines from Manchester; one of the main routes proposed is by way of Bolton and Darwen to Blackburn. Other routes include: by Warrington to Liverpool, and by Huddersfield to Leeds.

London.—Stoke Newington.—The Council has received a letter from the L.C.C. suggesting that the appeals to Quarter Sessions against the rates in respect of the tramway lines in Stoke Newington should remain in abeyance until the decision is given in the expected appeal to the House of Lords in the case of the Tottenham U.D.C. and the Metropolitan Electric Tramways Co., and further suggesting that to save the expense of an appeal being entered against each rate, the final decision relating to the appeal against the general rate made in April last should apply to the current and future rates, and that if the London C.C. can substantiate a claim for repayment of any portion of the rate for the past half-year, the B.C. will make a similar repayment in respect of the current half-year, and any further rates affected by the appeal. The Finance Committee has decided to agree to this suggestion subject to all rates being paid in full, and an undertaking to refund any amount overpaid as from April 1st, 1912.

L.C.C.—At the first meeting of the L.C.C. after the vacation, an adjourned report of the General Purposes Committee, regretting that the Government did not intend to proceed with the establishment of a Traffic Board, was considered. Sir John Benn proposed an amendment declaring the desirability of the Council being made the road authority. The total traffic receipts of the L.C.C. tramways from April 1st to October 2nd were £1,124,836, as compared with £1,183,931 in the corresponding period of 1911. It is recommended that eight horse cars shall be adapted as trailers for use on the Woolwich routes, at a cost of about £1,400.

Yarmouth.—At the last meeting of the T.C., the tramways manager reported that the receipts during the past month were £2,681—a decrease of £560. The aggregate receipts from April 1st were £14,438—a decrease of £1,440. Commenting, Councillor J. Salmon said there must be something wrong when they had a deficit of £1,400. He complained that the cars were run too close together. He had seen as many as seven in a line. Councillor C. A. Campling said the tramways had suffered through the bad weather, but the receipts were still a little ahead of last year. Last week there was an increase of £56, which did not appear in the month's takings reported.

Radcliffe.—The Council has decided to inform the Bury Corporation and the Whitefield D.C. that owing to the large expenditure which would be involved it cannot see its way to double the tramway track from Radcliffe to Whitefield. The argument for the double track was that it would improve the tramway connection between Radcliffe and Manchester.

Rastrick.—The Halifax Corporation notified the Council that it intended to embody in its forthcoming Bill a request for powers to continue the tramway from the Brighouse terminus through Rastrick and into the Fixby area. The Council gave its consent.

Scarborough.—The town clerk has been instructed to communicate with the secretary of the tramway company with reference to the condition of the tramway tracks in the borough. In this connection it is interesting to note that the members of the T.C. met in Committee on Monday, when it was reported that a communication had been received from a company desirous of taking over the effects of the present tramway company and running railless cars. The matter will come up for discussion at a meeting of the Streets and Buildings Committee this evening.

South Crosland.—In connection with the application which the Huddersfield Corporation is about to make to Parliament for powers to extend its tramways in several directions outside the borough, the South Crosland Council has decided to ask the Corporation to include in its application an extension of its tramway system to Netherton.

Sowerby.—The D.C. has consented to the Halifax Corporation's providing tramway extensions or running motor-'buses in the Council's district as the Corporation may think fit, such consent to be without prejudice to the right of the Council to equip and run motor-'buses in the district. It was also decided to agree with the Halifax Corporation in that the period in which the Council may purchase the existing tramways under Sec. 43 of the Tramways Act of 1870, be extended to 31 years from the date of the coming into force of the Act of Parliament, for which the Halifax Corporation proposes to make application during the next session.

Wardle.—The District Council has approached Rochdale Tramways Committee with a view to the latter providing a service of cars from Wardle Lane to Wardle Village. It was pointed out that it would cost about £10,000, the length being nearly a mile, and that Wardle would have to bear the cost of construction and equipment. The cost being so great, the District Council will now consider the establishment of a motor-'bus service.

Watford.—Application has been made to the B. of T. for confirmation of an Order granted by the Light Railway Commissioners for the construction of a light railway at Watford in place of an abandoned scheme.

Wakefield.—Representatives of the Stanley and Ardsley East and West Councils recently decided to recommend that if the Yorkshire (West Riding) Tramways Co. would substitute the railless traction system, the application for withdrawal of the unconstructed lines under the Wakefield Light Railway Orders would not be opposed. The general manager of the company (Mr. England) has since written that unless the local authorities obtained the necessary powers, and provided the capital, it would not be possible for the company to do anything further in the matter this year, and that it must proceed with the application for leave to abandon the unconstructed lines.

TELEGRAPH and TELEPHONE NOTES.

Austria.—A wireless telegraph station is to be set up at Laibach for the distribution of weather forecasts throughout the whole of the province of Carinthea. The German Wireless Co. in Berlin will supply the equipment, including transport and erection, at the price of 12,000 kronen. The antennæ will be set up on the Castle on the Schlossberg.—*Der Elektrotechniker.*

Channel Steamers.—The Northern of France Railway Co. have installed wireless telegraphy on their mail steamers running between Calais and Dover. All the passenger boats using Dover, Calais, Ostend, Folkestone and Boulogne are now fitted with wireless and can communicate with both sides of the Channel. —*The Times.*

Constantinople.—The *Journal* of the British Chamber of Commerce of Turkey says that the Société Anonyme Ottomane des Téléphones de Constantinople expects to inaugurate its service by the end of August, 1913, which is within the period specified in its convention with the Government. The company has now a technical staff of some 30 persons engaged in supervising the laying of its lines. It has to date some 5,000 km. of cable, 3,000 km. of underground wire, and 30,000 km. of piping in position. The installation will be underground in the city proper, to Bebek on the European, and to Scutari on the Asiatic shores of the Bosphorus, and in Prinkipo, the largest of the Princes' Islands. The company has to date received subscriptions for 2,101 stations, representing an annual income of £T15,000, which is in excess of its own estimates of subscribers as the work progressed. Of the subscribers 22 per cent. are purely Turkish. The company has imported from Great Britain 30,000 km. of cable, 10,000 km. of wire and 23,000 pipes, which has been cited as bearing out the economic principle of commerce following capital.

Germany.—Active progress is being made with the erection of the large wireless station at Neumünster. It will be equipped with three masts, each 65 m. high, made out of a special kind of durable and tough wood by the patent process of the firm of Meitzer, of Darmstadt. When finished the station will be worked only by the military authorities. It is intended to serve principally the purposes of the Navy, but it will also be available for the general public. It will form an important link betwixt the stations on the Baltic and on the North Sea.—*Hamburg Correspondenz.*

Imperial Wireless System.—On Friday last in the House of Commons, the debate took place on the Postmaster-General's motion to appoint a Select Committee, to investigate the circumstances connected with the negotiation and completion of the agreement between Marconi's Wireless Telegraph Co., Ltd., and the Postmaster-General for the establishment of a chain of Imperial wireless stations. Sir Henry Norman, while dissociating himself emphatically from any suggestion that the transaction was tainted with corruption, which he believed to be without a shadow of foundation, attacked the agreement on the ground that it was a bad bargain. He said they were all agreed that the wireless chain was very desirable, but he held that the stations under the agreement would not be owned by the State, and that the arrangement was unbusiness-like. The Government might have to pay a royalty for 28 years on a patent having a life of only 14 years. If the Postmaster-General determined the agreement, he would still have to pay the company £60,000 for each station, though he could no longer use a single piece of Marconi apparatus. He had the right under the Patents and Designs Act to use any invention for the service of the Crown on terms to be prescribed by the Treasury, but he had contracted himself out of that right. The agreement would have the effect of creating a gigantic monopoly, which would restrict the development of wireless telegraphy. He had no hostility towards the Marconi Co. or Mr. Marconi himself, who had done more than anyone else to make wireless telegraphy commercially practicable. He alleged that a number of different companies were practically carrying out long-distance wireless communication, and ought to have a hearing.

Mr. G. Terrell spoke on similar lines, and pointed out that since July last year the company's £1 shares had advanced from £2 6s. to £8 2s.

Major Archer-Shee, Sir G. C. Marks, Sir F. Banbury and others also criticised the agreement adversely.

The Attorney-General denied that he had been in any way concerned in the negotiations, or had had any dealing in the shares of the company.

Lord R. Cecil, while expressing complete confidence in the integrity of the Government, pointed out the necessity of the fullest possible inquiry into the matter.

Mr. H. Samuel then categorically denied, on behalf of himself and his colleagues, the truth of the rumours that had been referred to, and described the course of the negotiations with the company, which had been supervised by a special committee. He explained that the royalty contract could be terminated by the Postmaster-General at a moment's notice; if the Government ceased to use a patent at any time, payment would cease. Royalties would only be payable for valid unexpired patents. The Post Office could replace or supplement the Marconi apparatus with other apparatus at any time, and the company would have no right to object. He admitted that, according to the agreement, for five years any additional stations would have to be erected by the Marconi Co.; but the company had voluntarily suggested that this provision should be dropped, and the Government had a free hand to introduce any other system at any time for any new station, and to cease using Marconi apparatus at any station, and to cease paying royalty. The engineers of the Post Office and the Admiralty had estimated the cost of the stations, if erected by themselves on the same specification, at £60,800, and the Norwegian Government had entered into a contract with the Marconi Co. to erect long-range stations, excluding buildings and foundations, at £70,000, besides paying a royalty of 10 per cent. on the gross receipts, not for 18, but for 25 years. Under the contract the Post Office obtained the use of the company's patented and unpatented inventions, present and future, its valuable secret inventions, and the experience of long-range wireless telegraphy which the Marconi Co. alone possessed, as well as its technical assistance and advice so long as the royalty lasted. At the end of the 28 years the Government would have the right to use the company's patents, however new, without extra charge; and they were securing the release of the Admiralty and the Post Office from certain restrictions under their agreements. The rise in the value of Marconi shares was not merely due to the conclusion of the agreement; the company paid no dividend at all on the ordinary shares until 1911, for which year 20 per cent. was distributed. Moreover, in October, 1911, the company bought the Lodge-Muirhead master patent, and it had won two test actions against the United Wireless Co. and the Clyde Steamship Co. All these circumstances tended to increase the value of the shares. Nothing was to be paid to the company on account until the stations were completed, and the company proved that communication could be effected over the distance required. They could not be certain that the Poulsen Syndicate could cover the distance both by day and by night, and the Committee decided that the Poulsen offer could not be accepted without a test, which would have occupied 12 months. The Committee of Imperial Defence decided in May, 1911, that the six stations ought to be built, as they were of far greater strategic than commercial importance,

and that the matter was one of urgency. Unnecessary delay, therefore, was out of the question. The company's terms were greatly reduced in the course of the negotiations. He asked what other course could have been taken. The motion was agreed to without a division.

Switzerland.—A wireless receiving station for specially long distances has been installed at the Zurich Meteorological Observatory, in order to effect connection across the Alps with Paris, Norddeich and the German Trinity House. The possibility of so doing was unexpectedly demonstrated on the 20th ult. by a message being picked up which had been sent from the Austrian station at Sebenico to an Austrian warship in the Adriatic.—*Der Elektrotechniker.*

Telegraph Clerks' Grievances.—The Select Committee which is inquiring into wages and other conditions of employment in the Post Office resumed its sittings on Tuesday, and Mr. Ash, the chairman of the Postal Telegraph Clerks' Association, submitted a claim for a higher scale of wages, a seven hours' working day, changes in the arrangement of duties, and improvements in regard to holidays.—The *Times.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aldershot.—November 5th. Balancer for the U.D.C. See "Official Notices" to-day.

Australia. — South Australia. — November 27th. 18 miles paper-insulated cable, 155,000 jointing sleeves, also switchboard cable (Scheduled 248). See "Official Notices" to-day.

December 11th.—Line material (Schedules 250-252), and submarine telegraph cable and cable tank, for the P.M.G.'s Department. See "Official Notices" to-day.

December 17th. Three sections of common battery multiple switchboard and other equipment, for the P.M.G.'s Department. See "Official Notices" to-day.

Victoria.—October 22nd.—(*a*) 37,000 carbon filament lamps, and (*b*) insulated lead-covered copper cables, for the Melbourne City Council. See "Official Notices" October 4th.

November 12th.—Deputy P.M.G., Melbourne. 100 electrical registers. High Commissioner's Office in London.

November 19th.—One mercury vapour converter, for the P.M.G.'s Department. See "Official Notices" Oct. 11th. Also two batteries and a 4-K.V.A. single-phase transformer. High Commissioner in London.

Western Australia.—November 5th. Telephone switchboards to Stores Schedules 222 and 223, for the P.M.G.'s department, Perth. See "Official Notices" October 11th.

Austria.—October 29th. The Austrian State Railway authorities in Prague are inviting tenders for an electric lighting installation at the railway station at Weseli-Mezimosti.

Vienna.—November 1st. Tenders are invited for the supply of 657 red larch telegraph poles of various sizes for the Austrian post and telegraph service. Particulars, with printed tender forms, from the K.k. Post und Telegraph Direction, Hetzgasse II., Wien III.

Barrow-in-Furness.—November 5th. Electrical and steam plant, &c., in connection with the electricity works extensions, for the Corporation. See "Official Notices" to-day.

Belgium.—Antwerp.—November 25th. Tenders are invited for the supply of two moving bridges (ponts basculants), with mechanical and electric equipment, for the Meuse-Escaut Canal. Guarantee 40,000 francs. Particulars (0·40 franc), Chef de Service, Direction des Ponts et Chaussees, Rue van Schoonbeke, 74, Antwerp.

Bradford.—October 19th. The tramways department are inviting tenders for miscellaneous stores during the year ending December 31st, 1913. Specifications, &c., from Tramway Offices, 7, Hall Ings, Bradford, on payment of £1 1s., returnable.

Canada.—October 31st. One 500-B.H.P. Diesel engine, alternator, exciter, switchboard, tungsten street lighting apparatus. Specification will shortly be available at Board of Trade Commercial Intelligence Department in London.

Dublin.—November 4th. General stores for a year, for the Dublin United Tramways Co., Ltd. See "Official Notices" to-day.

Electric lighting of Messrs. Brown & Nolan's new printing works. Mr. T. Tomlinson, B.E., Dublin.

November 5th.—3,000-KW. steam turbo-alternator, with exciter, condensing plant, piping, &c., for the Corporation. See "Official Notices" to-day.

France.—Dole.—October 26th. Supply and installation of a transformer and an electric motor. Particulars from the Sous-Intendance Militaire, Quartier Bernard, Dole (Jura).

Glasgow.—The Caledonian Railway Co. invite tenders for stores, including electric lighting material and fittings and telegraph appliances, telephones, &c. Mr. A. J. Easton, stores superintendent, 321, Charles Street, St. Rollox, Glasgow.

Gillingham.—October 22nd. One 500-H.P. Diesel engine and alternator, for the Corporation. See "Official Notices" October 4th.

Huddersfield.—October 31st. Slack coal for a year, for the Corporation electricity works. Borough Electrical Engineer, St. Andrew's Road.

London.—A recommendation was before the L.C.C. on Tuesday to purchase a gas engine and alternator (cost, £145) for the Poplar L.C.C. School of Engineering and Navigation.

Battersea.—October 25th. Twelve internal telephone instruments and lines, for the B.C. See "Official Notices" to-day.

L.C.C.—November 4th. Carbons, fittings, insulating materials and lamps, for a year. See "Official Notices" to-day.

Mossley.—The Borough Education Committee is inviting tenders for wiring and fittings for electric lighting of the New Milton Council School. Forms of tender and specification from the architect, Mr. F. Quentery Farmer, 20, Sir Thomas Street, Liverpool.

New Zealand.—December 16th. Two 150-B.H.P. Diesel engines, two 100-KW. dynamos, balancer, motor-generator, switchboard, crane and oil tanks for Miramar (Town Clerk). Deposit £200. Board of Trade Commercial Intelligence Department, London, E.C.

Nottingham.—October 24th. The Tramways Committee is inviting tenders for (1) steel tramway poles; (2) malleable-iron pole fittings; (3) cast-iron pole fittings. Specifications and forms of tender (21s., returnable) from Mr. Arthur Brown, City Engineer, Guildhall, Nottingham.

Rio de Janeiro.—November 11th. Tenders to the Directoira Geral de Correios, Telegraphos e Illuminacão, Ministerio da Viação e Obras Publicas, Rio de Janeiro, for the construction and working of an overhead or underground telephone system designed to join up the cities of Rio de Janeiro and São Paulo. The *Diario*, containing further particulars, may be seen at the Commercial Intelligence Branch of the Board of Trade, London, E.C.—*Board of Trade Journal.*

Rochdale.—October 23rd. Steam turbo-alternator, condensing plant and pipework, for the Corporation. See "Official Notices" October 11th.

South Africa.—November 18th. The Municipal Corporation of Cradock, Cape Province, is calling for tenders for two 50-KW. Diesel oil engines and dynamos complete, also supply mains and public lighting. Specifications from Mr. R. A. Paterson, town clerk, on deposit of £2 2s.

Spain.—Madrid.—November 11th. Applications are invited for a concession to construct and work an electric tramway in Madrid. Provisional guarantee, 2,845·25 pesetas. Particulars of the Ministerio de Fomento, Madrid.

Stockport.—October 21st. 1,000 Osram metal-filament electric lamps for Stepping Hill Hospital, Hazel Grove. Mr. Chas. F. Johnson, clerk to the Guardians, Union Offices, Shaw Heath, Stockport.

Tonbridge.—October 28th. One 100-KW. Diesel engine and generator, and alterations and additions to switchboard, for the U.D.C. See "Official Notices" October 11th.

CLOSED.

Arnside.—The P.C. has accepted the tender of Messrs. Thos. Wilkinson, Ltd., of Arnside, for erecting fittings for public lighting and supplying current.

Australia.—Sydney.—The *Australian Mining Standard* reports the placing of the following contracts by the City Council:—

1,000-KW. motor-generator, £3,145.—N. Guthridge, Ltd.
Wright's maximum demand indicators, £612.—W. G. Watson & Co.

The *Mining and Engineering Review* (*Tenders*) records the placing of contracts as follows:—

Tasmania, P.M.G.'s Department.—
Paper-insulated lead-covered cable.—W. T. Henley's Telegraph Works Co., Ltd.
Copper and bronze wire (41 tons), copper cable and electric light cable,—B.I. and Helsby Cables, Ltd.
2,000 dry cells.—J. C. Fuller & Son, Ltd.
6,000 zincs.—I.-R. G.-P. and T. Works Co., Ltd.
100 telephones and a switchboard.—Western Electric Co. (Aus.), Ltd.
10,000 porcelain insulators (2½d.).—Noyes Bros.
3,000 insulators (transposition, 1s. 6½d. each).—Bullers, Ltd.
8,000 shackles and 2,000 tubes.—Lawrence & Hanson Electrical Co., Ltd.
Brake material and gear (£1,628 and £1,058).—Westinghouse Brake Co. of Australia.
Electric light cables (£149).—Noyes Bros.

The following appear in the *Australian Mining Standard*:—

Melbourne, P.M.G.'s Department.—
Distributing boxes.—W. T. Henley's Telegraph Works Co., Ltd.
Cable (£11,095) also switchboard cable (£907).—Australian Metal Co., Ltd.
150 open circuit condenser telephones (£3 2s. 6d. each).—Z. W. Garrington and Son.
Carbon and metal-filament lamps.—Unbehaun & Johnstone, Ltd.

Brisbane, P.M.G.'s Department.—
1,500 Cordeau insulators (5½d.).—T. Zwicker & Co.
60,000 porcelain insulators ("A") £1,300.—British and Foreign Indent Co.
60,000 porcelain insulators ("B") 17s. 10d. per 100.—Webster & Co.
Instruments, copper blocks for lightning arresters, &c.—I.-R. G.-P. and Telegraph Works Co., Ltd.
Magneto bells, condensers, receivers, telephones, &c.—J. Paton & Co.
1,000 protectors (2s. 2d. each), telephone sets, receivers, &c.—Western Electric Co. (Aus.), Ltd.
Tinned copper conductors.—Brabant & Co.

Adelaide, P.M.G.'s Department.—
Bells, telephones, &c.—J. Bartram & Son Propty., Ltd.
Condensers, cords, &c.—B I. and Helsby Cables, Ltd.
Condensers, switches, and 600 telephones.—Western Electric Co. (Aus.), Ltd.
28 miles of wire. T. Zwicker & Co.; 25 miles of wire.—Callender's Co. (Noyes); 5 miles of conductors.—Lawrence & Hanson Co.
Bells, fuses, &c.—I.-R. G.-P. and T. Works Co., Ltd.

Austria.—The Austrian Siemens Electricitäts-betriebe Gesellschaft, of Vienna, has secured the contract for the electric lighting of the town of Turn.

Barnes.—The U.D.C. has accepted the tender of Messrs. Wm. Cory & Son and Messrs. John Hudson & Co., Ltd, for the supply of 1,000 tons of Harton rough or Hillhouse coal, and 1,000 tons of Wemyss or Bridgness coal, for the electricity undertaking.

Birkenhead.—As Messrs. Worsley & Page, Ltd., whose tender had been accepted for the supply of armature coils to the Tramways Department, had notified the Corporation that they were unable to carry out their contract, the tender of the Manchester Armature Repair Co. has been accepted in place thereof.

Colchester.—The T.C. has accepted the tender of Messrs. Cory & Son, Ltd., for 300 tons of Shirebrook nutty slack coal for the electricity works, at 14s. 10d. per ton.

France.—The French Post and Telegraphs, Paris, have just placed the following contracts with Le Matériel Téléphonique (Ancienne Maison G. Aboilard & Cie), Paris:—15 km. 14-pair cable, conductor 2·5 mm.; 10 km. 7-pair cable, conductor 2 mm.; installation of 3,600-line telephone exchange for Roubaix (Nord); transfer of the provisional exchange—installed at Gutenberg after the fire of 1908—to the new building.

Ipswich.—Messrs. Venner & Co. have received the contract for Chamberlain & Hookham meters for the ensuing year from the Corporation.

Italy.—La Société Italiana Westinghouse, of Vado-Ligure, have secured a contract from the Italian State Railway authorities in Rome, for the construction of 45 2,000-H.P. electric locomotives and eight machines of 2,600 H.P.

London.—L.C.C.—The Highways Committee received the following tenders for electrical dischargers for use in tramway sub-stations:—

Johnson & Phillips, Ltd.	(recommended)	£2,639
British Westinghouse Co., Ltd.		2,732
Spagnoletti, Ltd.		2,785
General Electric Co., Ltd.		2,861
Ferranti, Ltd.		2,907

Estimate of Chief Officer, £2,200.*

The difference between the estimate* and the tenders is "accounted for by the recent general increase in the price of raw material."

Four patent car-washing platforms for Streatham car-shed extension are to be provided by Messrs. Hayward & Co., Ltd., for £247.

The following tenders were received during the recess for shop trucks and lathes for the third section of the central car repair depôt:—

Three Electrically-Propelled Shop Trucks, &c.

Brush Electrical Engineering Co., Ltd.	(accepted)	£690
Scholey & Co., Ltd.		753
S. H. Heywood & Co., Ltd.		908
British Westinghouse Co., Ltd.		916
Hurst, Nelson & Co., Ltd.		975

Three Wheel-Turning Lathes.

	Fitted with screw gear for the headstock rams.	Fitted with power gear for operating the headstock rams.
Buck & Hickman, Ltd.	£2,445	£2,532 (accepted)
Tangyes, Ltd.	2,673	2,659
Pollock & MacNab, Ltd.	2,680	2,720

Shoreditch.—The B.C. Lighting Committee is accepting the quotation of the Western Electric Co., Ltd., at £300, for additional lead-covered cable required before the end of the year for mains extensions.

The following contracts for coal required by the Lighting Committee, up to march next, have been placed:—

	Approx. B.T.U's.	Price per ton. s.	d.	Quantity. Tons.
J. Hudson & Co. (Bank, Bridgeness or Wemyss)	12,500	16	9	3,000
G. J. Cockerell & Co. (Cowdenbeath)	12,200	16	7	2,000
ditto (Nailstone D.S. nuts)	13,500	15	6	1,000
Harrison, Tidswell & Co. (Whitwick deep slack)	13,500	18	6	1,000

Southwark.—The B.C. has accepted the tender of Messrs. Alfred Blackmore & Co. for the supply of 5,000 tons of pea coal, at 14s. 6d. per ton, and 5,000 tons of slack coal, at 14s. per ton, for use at the electricity works.

The following tenders have been received for the supply of (*a*) 440 yds. of ·1 × ·05 × ·1 and (*b*) 440 yds. of ·05 × ·03 × ·05 triple-concentric, paper-insulated lead-covered and jute-served cable:—

	(*a*)	(*b*)
Aubert Grenier & Co.	£122	£77
British Insulated and Helsby Cables, Ltd.	128	79
Callender's Cable and Construction Co., Ltd.	135	84
Connolly Bros., Ltd.	143	91
Drake & Gorham, Ltd.	173	89
Electrical Engineering and Equipment Co., Ltd.	(accepted) 118	73
General Electric Co., Ltd.	137	85
W. T. Glover & Co., Ltd.	127	80
W. T. Henley's Telegraph Works, Ltd.	127	91
Johnson & Phillips	135	83
Siemens Bros. & Co., Ltd.	127	78
R. R. Todd	120	75
Western Electric Co., Ltd.	127	79

Lowestoft.—The tender of Messrs. Wm. Cory & Son, Ltd., for 1,500 tons of Newsted nutty slack coal, at 13s. 6d. per ton, has been accepted by the T.C.

Newcastle.—The Guardians have accepted the tender of Mr. A. Davidson, at £288, for electrically lighting the cottage homes.

Rotherham.—The following tenders have been accepted by the T.C.:—
Reason Manufacturing Co., Ltd.—Electrolytic meters.
Chamberlain & Hookham.—Motor meters.
Siemens Bros. Dynamo Works, Ltd.—Watt-hour meters.
Callender's Cable and Construction Co., Ltd.—Cable.
British Westinghouse Co., Ltd.—Gear wheels and Okonite tape.
Imeson & Finch.—Trolley heads, cheeks, harps, wheels, and controller fingers.
Breckneil, Munro & Rogers.—Trolley bushes, spindles and washers.
Watlington & Co.—Pinion wheels.
Wilson, Ltd.—Slipper blocks.
Le Carbone.—Carbon brushes.
Weldless Chains, Ltd.—Brake chains.
Dick, Kerr & Co., Ltd.—Armature coils and axle collars.
Smith Bros., Ltd.—Cable, lamps, &c.
Anti-Attrition Metal Co.—Armature bearings and axle brass keeps.
National Rail and Tramway Appliances.—Brake shoes.
Tenter Foundry Co.—Brake castings, &c.
Sheepbridge Coal and Iron Co., Ltd.—Coal for electricity and tramway departments, at 7s. 2d. per ton.
W. A. Durnford (Earl Fitzwilliam's Collieries).—8s. 6d. per ton.

Rawtenstall.—For the supply of a high-tension switchboard panel, the T.C. has accepted the tender of Messrs. Siemens Bros., Ltd.

Rugby.—The tender of the British Westinghouse Co., Ltd., has been accepted by the U.D.C., for the supply of three transformers.

Southampton.—The Tramways Committee of the T.C. has accepted the tender of Messrs. Wm. Griffiths & Co., Ltd., at £2,210 for reconstructing the tramways in a portion of Above Bar Street.

Stretford.—The U.D.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., at £64, for the supply of ½-mile of single braided and compounded ·125 cable.

Sunderland.—The T.C. on the 9th inst., on the recommendation of the Electricity Committee, accepted the following tenders:—
Averys, Ltd.—Weighbridge.
Cox-Walkers, Ltd.—Regulator for turbine.
Falkirk Iron Co.—Brackets for arc lamps.
Drake & Gorham.—Cast-iron bases.
Ferranti, Ltd.—Meters.

On the recommendation of the Tramways Committee, it was decided to obtain an oxy-acetylene welding plant, at a cost of £22.

Swansea.—The tender of Mr. J. S. Brown has been accepted by the Guardians for wiring the administrative block at the Workhouse.

Tavistock.—The U.D.C. has accepted the tender of Messrs. Stewart & Moore, at £43, for the installation of an electric call system.

Wallasey.—The Tramways Committee has ordered six new tramcars from the Brush Electrical Engineering Co., Ltd.

Walsall.—The tender of Callender's Cable Co., Ltd., has been accepted by the T.C., at £667, for supplying and fixing feeders, pilot wires and conduits.

Watford.—The U.D.C. has accepted the tender of the British Westinghouse Electric and Manufacturing Co., Ltd., for switchgear for additional sub-stations.

West Hartlepool.—The tender of Messrs. J. W. White and Co. has been accepted by the T.C. for the erection of a new power station and foundations for cooling tower ponds. The tender of the Callender's Cable Co. has been accepted for three-core paper-insulated 6,000-volt three-phase high-tension cables, and for low-tension rubber cables and wiring.

Witney.—The U.D.C., upon the recommendations contained in the report of Messrs. May & Hawes, the consulting engineers, has accepted the following tenders for the extensions of the electric supply undertaking:—
Suction gas plant and accessories.—Daniel Young, Witney, £1,384.
Battery booster.—Crompton & Co., Ltd., £74.
Switchboard.—Crompton & Co., Ltd,, £178.
Boxes and pillars.—W. Lucy & Co., Ltd., £82.
Cables.—Callender's Cable & Construction Co, Ltd., £566.

Worcester.—The T.C. has accepted the tender of the South Wales and Cannock Chase Coal Co., for coal for the electricity works, viz, screened nuts, 15s. 6d. per ton; bright slack, 9s. 3d. per ton; No. 2 slack, 8s. 3d. per ton; and that of Messrs. Underwood and Co. for Tamworth nuts, at 13s. 9d. per ton.

Yarmouth.—The T.C. has accepted the tender of Messrs. Meyers, Rose & Co. for the supply of 3,000 tons of Derbyshire slack coal, at 10s. 10½d. per ton f.o.r.

Yorkshire.—Messrs. Venner & Co. are equipping the Yorkshire (West Riding) Electric Tramways with Chamberlain and Hookham car meters.

FORTHCOMING EVENTS.

Association of Mining Electrical Engineers (West of Scotland Branch).—Friday, October 18th. At 7.30 p.m. At the Royal Technical College, Glasgow. Presidential address by Mr. M. Brown, presentation of certificates, and paper on "Notes on Electricity Rule No. 7," by Mr. A. B. Muirhead.

Electro-Harmonic Society.—Friday, October 18th. At the King's Hall, Holborn Restaurant. Smoking concert.

Engineering and Machinery Exhibition.—At Olympia. Daily to October 26th.

Junior Institution of Engineers.—Wednesday, October 23rd. At 8 p.m. At the I.E.E., Embankment, W.C. Paper on "Scientific Shop Management on the Taylor System," by Mr. G. C. Allingham.

Physical Society.—Friday, October 25th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "The Constitution of Mercury Lines Examined by an Echelon Grating and a Lummer-Gehrcke Plate," by Prof. H. Nagaoka and T. Takamine; "Note on the Mutual Inductance of Two Co-axial Circular Currents," by Prof. H. Nagaoka; and "The Absorption of Gas in Vacuum Tubes," by Mr. S. E. Hill.

Institution of Mechanical Engineers.—Friday, October 25th. At 8 p.m. Paper on "Characteristic Dynamical Diagrams for the Motion of a Train during the Accelerating and Retarding Periods," by Prof. W. E. Dalby; and paper for discussion, in writing only, on "Theory and Experiment in the Flow of Steam through Nozzles," by Prof. J. B. Henderson.

Association of Engineers-in-Charge.—Saturday, October 26th. At the Holborn Hall. Whist drive and dance.

NOTES.

Erratum.—In the third line from the end of our first leaderette on page 603, the word "purchaser" should read "seller."

Electricity in Agriculture.—An International Congress of Electroculture will be held at Rheims on October 24—26th.

For Sale.—The York Corporation Electricity Department has for disposal two Lancashire boilers. See our advertisement pages in this issue.

The Electro-Harmonic Society.—The first smoking concert of the season will be held to-night, Friday, October 18th, at 8 o'clock, at the Holborn Restaurant (King's Hall). The artists are as follows: Vocalists, Senor José de Moraes (tenor), Mr. Herbert Heyner (baritone); violoncello, Mr. W. H. Squire; conjuror and ventriloquist, Mr. Arthur Besovi; entertainer at the piano, Mr. Warwick Pryce; demonstration of memorisation, Memora; humorists, Mr. Fred Curtis, Mr. J. M. Campbell; solo pianist and accompanist, Mr. Bernard Flanders, A.R.A.M.

Libel Action.—In the London Sheriff's Court on 10th inst., a jury awarded Messrs. Debenham Storr & Sons £400 damages, and Mr. Benton, an auctioneer in the service of that firm, £100 damages, in an action brought against Mr. C. S. Northcote for libel in connection with a sale of some of his household goods. Execution was stayed for a week.

The Liverpool Appointment.—The applications received for the appointment of city electrical engineer have been referred to a special sub-committee, to select not less than three and not more than six candidates to appear before the Electricity Committee.

Institution and Lecture Notes.—Association of Mining Electrical Engineers (W. of Scotland Branch).—A meeting was held in Kilmarnock on October 5th, at which Mr. Alexander Anderson, of Wishaw, vice-president of the Association, delivered a lecture on "Electricity: From the Generator to the Coal Face."

Institution of Electrical Engineers (Manchester Local Section).—The first meeting for the 1912-13 session will be held in the Banqueting Hall of the Midland Hotel, Manchester, on Friday, November 1st, at 7.30 p.m. As Mr. A. A. Day, the chairman, will, for reasons of health, be unable to be present and read his address, this will be read by Prof. E. W. Marchant, the vice-chairman. A smoking concert will follow. The other meetings of the session will be held at the Physical Laboratory of the University of Manchester. The list of papers, authors, &c., is as follows:—

Tuesday, November 5th.—Mr. F. Creedy, on "The Turbo-Converter. A High-speed Direct-current Generating Unit."
November 19th.—Mr. J. S. Peck, on "Earthed *v.* Unearthed Neutrals on Alternating-current Systems."
December 3rd.—Messrs. J. G. Cunliffe and R. G. Cunliffe, on "Some Problems in Traction Development—Street Railway Feeding Networks."
December 17th.—Mr. P. Bucher, on "Electric Welding."
January 14th, 1913.—Mr. F. C. Aldcus, on "Starting and Speed Control on Induction Motors."
January 28th.—Mr. F. H. Whysall, on "The Use of a Large Lighting Battery in Connection with Central Station Supply."
February 11th.—Mr. H. Clifford Palmer, on "Advertising Electricity."
February 25th.—Messrs. S. L. Pearce and H. A. Ratcliff, on "Some Recent Developments in the Manchester Street Lighting."
Friday, February 28th.—Annual dinner.
March 11th.—Dr. E. Rosenberg, on "Self-starting Synchronous Machines."
April 1st.—Mr. W. Browning, on "Electric Driving of Textile Factories."
April 8th.—Annual General Meeting and lecture by Prof. E. Rutherford, M.A., D.Sc., F.R.S., &c.

Institution of Post Office Electrical Engineers.—The opening of the winter session of the North-Western Centre took place at Preston on October 9th, when Mr. H. R. Kempe, M.I.C.E. (Council chairman), read a paper on "Reminiscences of Telegraphy of the Past." Mr. T. E. P. Stretche (superintending engineer) presided. The lecturer dealt with the progress made in the various branches of telegraphy from 1837 until the present day, and the paper was copiously illustrated by specially prepared lantern slides.

On Monday, at the I.E.E., Mr. H. Samuel presented the prizes for papers which had been read, and stated that a decision had been reached regarding the classification of the Engineering Department which, he thought, would prove satisfactory to very many of the staff. Mr. R. Myles Hook then read a paper on "Correct Time."

Institution of Electrical Engineers.—The first London meeting for the new session will be held on Thursday, Nov. 14th.

Gas Exhibition Next Year.—The *Gas World* reports that at a meeting of the Council of the Institution of Gas Engineers, held at Manchester last week, the Provisional Joint Committee of the Gas Exhibition reported that it had been decided to hold the Exhibition in October, 1913, at Shepherd's Bush. The necessary steps have been taken to carry out the work of organisation, and a number of halls have been secured at the White City for the purpose. Houses and flats, shops, workshops, a hospital, a schoolroom, a laundry, offices, &c., are to be equipped with gas lighting and heating, and the most up-to-date apparatus associated with the production of gas will be exhibited.

Appointment Vacant.—Assistant tramways electrical engineer for the Hull Corporation (£200). See our advertisement pages in this issue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—A presentation of a handsome case of cutlery was made by the staff of the Middlesbrough Corporation Electricity Department to their chief clerk, Mr. Henry S. Dawson, on the occasion of his wedding. Mr. Dawson has skippered his department for over 10 years.

Mr. J. E. Allen has resigned his position as outside superintendent of the Ilford U.D.C. Electricity Department.

The Ealing Borough Council has advanced the salary of the assistant electrical engineer to £290. Alderman H. W. Peal, J.P., chairman of the Committee, reported that the maximum was fixed five years ago, since when the responsibilities and duties of this official had very largely increased.

Tramway Officials.—Mr. Douglas Gray, tramway manager at Keighley, has resigned. The Tramways Committee has recommended that Mr. H. Webber, borough electrical engineer, be appointed manager *pro tem.*

General.—We regret to learn from the daily Press that as the result of the recent accident to Mr. Marconi, the power of vision has diminished in the injured eye, and fears of the loss of the eye have increased.

Mr. John Hall, secretary to the Scarborough Electric Supply Co., whose term of office as a member of the Town Council expires at the end of this month, has intimated to his ward committee that he is unable to accept their invitation to be nominated for a seat on the Council. Mr. Hall has seen a fair amount of service on the Town Council, and was some years ago an Alderman of the Borough.

Mr. C. B. Gresham, of the Electrical Co., Ltd., has joined the staff of Messrs. Siemens Bros. Dynamo Works, Ltd., in their meter department at Upper Thames Street, E.C. Mr. W. F. Birch, of the meter testing room of the Electrical Co., Ltd., has been appointed assistant manager of the meter department in succession to Mr. Gresham, who, as stated above, has resigned.

Mr. W. H. Booth, artesian and water supply engineer and oil expert, has removed to new offices at 8, Queen Street, Cheapside, E.C. Telephone No. "8305 Bank."

Mr. C. Jones, electrical engineer, West Cannock Colliery Co., Ltd., Hednesford, has been appointed as lecturer in Physics and Electrical Engineering, on the staff of the New Technical Institute at Hednesford, Staffs., recently opened by Sir Oliver Lodge. Mr. Jones has also been awarded the Premier Prize for the best paper read at the Association of Mining Electrical Engineers' meetings, Session 1911-12.

Mr. C. A. Gate, who was local manager of the telephones at Keighley, and has been transferred to Derby, has been presented by the staff with an inscribed silver tankard.

The *Mining and Engineering Review* (Aus.) states that Mr. J. W. Fraser, an engineer from the British Westinghouse Co., has gone to Tasmania to supervise the erection of the Hydro-Electric P. and M. Co.'s plant.

Mr. Charles Grundy has been the principal electrician to Blackpool Tower Co. for 20 years, and he is now leaving for Australia for health and family reasons. On October 11th 100 of the company's workers met to show their appreciation of Mr. Grundy. The manager, Mr. G. H. Harrop, presided, and handed to Mr. Grundy a cheque from the company and a substantial amount of cash in a purse, to which was attached a silver plate suitably inscribed—the gift of the officials and colleagues. Mr. Grundy also received a silver cigar case from Miss Pauline Rivers, directress of the Tower ballets, as an expression of her appreciation of his artistic illumination of her ballet productions.

Obituary.—Mr. Bennett Pell.—We regret to learn of the death of Mr. Bennett Pell, which occurred on September 20th at the age of 70 years. Mr. Pell passed away suddenly at Exmouth, the cause of death being angina pectoris. The deceased gentleman was born near Canterbury in 1842, and he received his professional training in the Submarine Telegraph Co.'s London station in 1857. He was transferred to their Emden station when the first direct

cable was laid from this country to Germany. He then joined the United Kingdom Telegraph Co., and was placed in charge of their Birmingham station at the unusually early age of 18. In 1863 he was appointed to the Indo-European Telegraph Department, and was in responsible positions in Persia until 1866, when he became personal clerk to Col. Robinson, at the Indian Office, whilst that gentleman was reorganising the Indian Telegraph Department. During the succeeding years Mr. Pell held important posts in connection with the Australasian and China telegraphs in Java and Singapore. To the latter place he was transferred in the year 1874 to take up the post of general manager of the Eastern Extension, Australasia and China Telegraph Co., Ltd. Whilst residing at Singapore, he established the first Telephone Exchange in the East, which was afterwards purchased by the Oriental Telephone Co. In 1882 Mr. Pell finally left the East; he joined Messrs. Johnson and Phillips in 1883, and brought out the famous Brockie-Pell arc lamp, which afterwards became the property of a limited company, with himself as managing director. Mr. Pell retired from active life in the electrical world in the year 1898. He was one of the oldest members of the Institution of Electrical Engineers, a Fellow of the Imperial Institute and a member of the London Chamber of Commerce.

We deeply regret to read of the death, which occurred on October 12th at Streatham, after a long illness, of Mr. Vaughan Pendred, M.I.Mech.E., &c., at the age of 76 years. The deceased gentleman was for 42 years editor of our contemporary, the *Engineer*.

We regret to record that the death occurred recently of Dr. F. H. Low, hon. sec. of the Rontgen Society, who, according to the *Times*, had occupied the post of medical officer to the X-ray department at the London Medical Graduates' College and Polytechnic, and at King's College Hospital.

CITY NOTES.

Dick, Kerr & Co., Ltd.

The annual meeting was held on Tuesday at the Cannon Street Hotel, E.C., Mr. Claud T. Cayley presiding.

The Chairman, before moving the adoption of the report (see Elec. Rev., page 588), explained that the reason the meeting was being held later than usual, was that during the last two or three years the business of the company had so changed that it was impossible for them to get the accounts from Australia, Japan, &c., in time for the accountants to get the books made up earlier. He expected that in the future the meetings would always be held about the end of October, instead of in September as previously. Proceeding to propose the adoption of the report, the chairman said it would be seen that the company had had a poor year, indeed the poorest year since the foundation of the business. Last year the directors indulged in an extremely moderate forecast, saying that should their hopes be fulfilled the prospects of a satisfactory result were encouraging. The prospects were encouraging at that time, and the non-fulfilment of their hopes was due partly to the fact that some of the contracts which had been completed during the past year had yielded a less profit than was anticipated, and partly to delays which took place in the commencement of new contracts which at that time seemed imminent. The contracts entered into during the last five years had been taken in the face of great competition, and, as much of the company's work was necessarily accepted a long time before it could be executed, a considerable number of contracts finished last year were in fact taken when such competition was at its keenest. In the immediate past the railway and coal strikes affected more particularly their manufacturing business at Preston, because, whilst they were themselves well provided with stocks of coal, they were greatly hindered in the execution of their orders, in fact, had to stop work at one time, because of the impossibility of getting in their raw materials, and also of making delivery of their manufactured goods. The net result in this department was that with the works' order book at the maximum, their net production during the 12 months under review was, with the exception of one year, the minimum since they entered that field ten years ago. The same remarks with respect to strikes applied to the contracting department, with the addition that it was also seriously affected by the dock strike, because of the impossibility of getting that raw material which was of all importance, namely, cement. The contracts they had in hand for this year they hoped would be remunerative. The order book was healthy, the Preston works being fuller than it had ever been of that class of manufacture best suited to it, and the very greatest care was being taken by the directors and management to take no orders that would not show at least a moderate profit. Turning to the balance-sheet, it would be seen the company's works were full, the stock of materials and work in progress there having, during the year, risen from £99,621 to £142,383—over 40 per cent. With regard to the other figures in the balance-sheet, the capital expenditure had been increased by £20,156. This was after writing off for depreciation on the same scale as usual, and represented extensions at Preston works principally in connection with the completion of the lamp works, which was now producing for the market. The debtors and contracts were somewhat less than last year, but these figures were fluctuating ones, which constantly varied within considerable limits. The sundry investments remained at practically the same figure, and the cash in hand was somewhat reduced, owing to the greater amount of work in progress. In conclusion, he might say that whilst the directors were disappointed in the result of the year's trading, they were convinced that there were many grounds for hope that the result revealed by the profit and loss account was one such as only came occasionally within the experience of any trading concern, and to that concern in particular. There never was a time in its history when its organisation was more complete, or when its reputation to produce the best article stood higher. They had an experienced and excellent staff, and a management devoted heart and soul to the best interests of the company. They might say he had not promised them much for the future, but he would promise them one thing—that if they later on in the meeting re-elected him as a director, he would spare no work on his part (and he knew he had the support of all his co-directors) in endeavouring to bring about a better state of things in the near future. They would have noticed from the report that they had lost two directors during the past year, Mr. John Kerr, the late chairman, and Mr. George Richardson, who, as stated, retired from the board for private reasons. He regretted it had been thought by one or two that this might have been in connection with the poor result of the profit and loss account for the year under review. He begged to assure the shareholders that their late colleagues were not men who would retire from the company for any such reasons, but, on the contrary, would most likely have stood by their co-directors, had they had an idea at the time they retired that the results would be so unsatisfactory. It was with very great satisfaction he was able to announce that Mr. John Sampson had accepted a seat on the board.

Mr. R. H. Prestwich seconded the motion.

Mr. J. B. Concanon said he thought it was due to the chairman that, on behalf of the shareholders, he (the speaker) should express his deep sympathy with the board, as well as with themselves, for the untoward incident of their having been obliged to pass the ordinary dividend this year. He would like to point out to those shareholders who were, perhaps, not so conversant with kindred companies as he (Mr. Concanon) was, that he did not think there was one of such concerns that had paid a dividend on its ordinary shares for years, and that was the first time that Dick, Kerr & Co. had had to pass the ordinary dividend. That, he thought, in itself was a remarkable testimony to the admirable manner in which the company had been managed in the past. With regard to the appointment of Mr. Sampson, he regarded it as a distinct acquisition for the company to have such a man on the board. He was a man of the very highest position in the commercial world, and he was a man of very independent and very strong views. They might rest satisfied that nothing would be left undone on the part of the chairman and the board to get the company back into a more prosperous state. Their chairman had been connected with the company for many years, and although his (Mr. Concanon's) personal interest was not very large as an ordinary shareholder, he had always taken a deep interest in the company from its very start. He could claim to have been the first man to give an electrical contract to the company when it started on its new career 10 years ago, and it had prospered ever since until this unfortunate year, when, as they knew, the circumstances were entirely exceptional. He was aware that the reason kindred companies had not paid any ordinary dividends for some time was not so much want of orders as the taking of business that was not profitable. He applauded the remark of the chairman that it was their intention not to take any business that did not show a fair profit. He thought it was a great pity that those companies who were competing with them could not see their way to come to some sensible businesslike understanding with one another not to cut prices, for he was satisfied that if some such arrangement could be come to, it would be to the advantage of all concerned. He noticed that they had investments in the balance-sheet representing about £149,000, and he would be pleased to know if there was any serious depreciation in that figure.

The Chairman, after thanking Mr. Concanon for the complimentary nature of his remarks, said that, as to the investments, they were all added together, and they were put in the balance-sheet at what they considered to be their true value, acting on the advice of their accountants.

The report was then adopted.

On the motion of Mr. Prestwich, seconded by Mr. D. C. Ellis, the chairman was re-elected a director, and the appointment of Mr. John Sampson to a seat on the board was confirmed.

The meeting closed with a vote of thanks to the chairman, his colleagues, the staff, &c.

Oriental Telephone and Electric Co., Ltd.—The directors have declared the following interim dividends:—3 per cent. on the 6 per cent. cumulative preference shares for the current year, less income-tax, and 3 per cent. on the ordinary shares, free of income-tax. The warrants will be posted on 31st inst. The share transfer books will be closed from 17th to 30th inst.

Indo-European Telegraph Co., Ltd.—The directors have declared an interim dividend for the half-year ended June 30th last at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 1st. The transfer books will be closed from 18th to the 31st inst., inclusive.

Provincial Cinematograph Theatres, Ltd.—The directors have recently declared a first interim dividend of 5 per cent.

New General Traction Co., Ltd.

The directors' report for the 16 months ended July 31st, 1912, states that the scheme of reorganisation of the company's share capital as passed by the shareholders, received the approval of the Court on July 23rd last, and for the purpose of bringing the accounts into line with such scheme they have been brought up to July 31st. The revenue received and accrued from the various sub-companies amounted to £37,521 for the period under review, against £22,657 in the previous year. The general expenses, including directors' fees and legal charges, amounted to £2,566 for the 16 months, as against £2,147 in 1910-11. The accounts for the period show a profit of £15,170. The directors recommend that this sum should be appropriated as follows: £10,480 to the payment of a 4 per cent. dividend, and that the balance of £4,690 be carried forward. The dividend received from the Coventry Electric Tramways Co. for the year ended December 31st, 1911, was increased to 9½ per cent. The Coventry Corporation has duly carried out the purchase of the Coventry tramways in accordance with the terms of the arbitration, of which particulars have already been sent to the shareholders. The accounts of the Norwich system show that there was an increase in the traffics for the year, and a decrease in the expenses. A dividend of 2 per cent. was received from that company for the year ended June 30th, 1911, as against 1½ per cent. for the previous year. The Douglas Southern Electric Tramways, Ltd., paid 7 per cent. on its preference shares and 1¼ per cent. on its ordinary shares. The income from the Philadelphia undertaking for the 16 months amounted to £20,147. The directors' reports and accounts of the Coventry, the Norwich, and the Douglas Southern Tramway Companies respectively are annexed to the report. The directors have appointed Mr. Charles Pakeman to a seat on the board.

The annual meeting is to be held on October 31st.

In respect of the reorganisation of the share capital, the new share certificates will be ready to be exchanged against the old preference and ordinary share certificates on and after October 23rd.

Prospectus.—*The Rose Automatic Target Co., Ltd.*—In our issue of May 24th last, we referred to a prospectus offering 19,000 shares of £1 each for subscription at par. Apparently there was then an insufficient response, for we have now received a second prospectus stating that the list was to be open from October 10th to 15th, for an issue of 21,000—thus giving the public a larger opportunity. The vendor of the patents has modified his terms, for he is now content to take only £2,000 in cash (as compared with £4,000 before), and £14,000 in fully-paid shares (as compared with £16,000 before). It is still proposed to acquire and develop the patents, and estimates of the manufacturing cost have still been prepared and carefully considered. Making their calculations of expenditure accordingly, and having regard to inquiries received, the directors are "of opinion" that there will be "satisfactory dividends." We do not now find any reference to the factory building near London that was under consideration last May, and Mr. Rose is only mentioned as technical adviser (not now as manager of the factory) at a salary of £400 per annum, the engagement being terminable after the first year at three months' notice. The company has been formed to acquire and develop the patent rights of what, as our readers know, is an excellent invention, but it is not clear what this word "develop" means, for there is no reference to any agreements as to manufacture, though it is stated that after paying for the patents, the proceeds of the issue will be devoted to "providing working capital for exploiting the invention." Our readers will not require us now to restate our criticisms of May last.

Associated Fire Alarms, Ltd.—The first report of the directors states that the accounts for the year ended June 30th, 1912, show a small profit of £112, after providing for depreciation. A considerable portion of the period was occupied in the reorganisation of the two businesses as a combined concern. The directors' expectations of economic working and reduced expenditure consequent upon the amalgamation of the businesses of the Pearson Fire Alarm, Ltd., and May-Oatway Fire Appliances, Ltd., have been fully realised; competition has been reduced and a substantial saving effected in working and other expenses, the full benefit of which will not be experienced until next year. Owing to pressure of other business, Mr. H. Cuthbert Hall, one of the original directors, has resigned his seat on the board. In the interests of economy the seat is not to be filled at present.

Ferranti, Ltd.—The directors report that for the year ended June 30th, 1912, the profit on trading was £51,759, and, after crediting discounts, interest and transfer fees, and deducting general establishment charges, repairs and renewals, legal expenses, bad debts and directors' and trustees' fees, there remains a balance of £24,333, which has been applied as follows:—Interest on prior lien debentures, £805; interest on first mortgage debenture stock, £5,600; interest on bank and temporary loans, £1,400; depreciation reserve account, £10,000 = £17,205, leaving a balance of £7,128. The amount at credit at June 30th, 1911, was £5,327, making £12,456. The directors recommend that this amount should be carried forward to the current year. The results for the year again show an improvement over those for the previous year. Owing to the expansion of the company's business arrangements are about to be made to issue £50,000 6 per cent. five-year notes. The proceeds, after repayment of the prior lien debentures, will be available for working capital.

The annual meeting is to be held at Basildon House, Moorgate Street, E.C., on Thursday, October 24th.

Parsons Marine Steam Turbine Co., Ltd.—The report states that up to June 30th the total horse-power of marine turbines of the Parsons type completed or under construction, amounts to 8,500,000 H.P.—an increase during the year of about 2,100,000 H.P.—of which total nearly 7,200,000 H.P. is employed for propulsion of warships and 1,300,000 in the mercantile marine and yachts. The directors recommend a final dividend of 5 per cent., making 10 per cent. for the year, absorbing £21,128, also a bonus of 2½ per cent., absorbing £5,282, leaving £18,810 to be carried forward.

Brisbane Electric Tramways Investment Co., Ltd.—The directors have declared an interim dividend at the rate of 8 per cent. per annum (4s. per share) on the ordinary shares for the half-year ended June 30th.

Monte Video Telephone, Ltd.—The directors report that for the year ended July 31st last, after providing for all charges in Monte Video and London, the net profit for the period was £25,120, as against £22,145 for the previous year. The interim dividends paid on May 1st last absorbed the sum of £4,343, leaving a balance of £20,777, plus £4,381 brought forward, making an available balance of £25,158. After applying £15,000 to depreciation of the company's property and plant, and transferring £1,500 to reserve fund, bringing that account up to £60,000, the directors recommend the payment of final dividends of 2½ per cent. upon the preference shares and 3 per cent. upon the ordinary shares, making for the year 5 per cent. on the preference and 6 per cent. on the ordinary shares, leaving a balance of £4,315 to be carried forward. The number of new subscribers during the year has again shown a moderate increase.

Cape Electric Tramways, Ltd.—The directors report that for the year ended June 30th, 1912, there was a profit of £77,586, and after providing for debenture interest, redemption of debentures, and taking into account the balance brought forward from last year, there is a net credit balance of £36,662. From this sum the reserve fund has been credited with £8,000, leaving £28,662. The operations show a further satisfactory increase in earnings on the figures of the previous year in both Cape Town and Port Elizabeth, and the consequent increase of profit enables the directors to recommend the payment of a dividend of 5 per cent., free of income-tax, on the ordinary shares. This will absorb £24,561, and the balance of £4,101 is to be carried forward. During the year the tramways carried in Cape Town 13,733,656 passengers, the receipts being £135,369, as against 13,318,110 passengers, with receipts of £131,702, for the year 1910-11. In Port Elizabeth 3,747,913 passengers were carried, the receipts being £39,822, as against 3,363,099 passengers, with receipts of £35,632, for the year 1910-11.

STOCKS AND SHARES.

Tuesday Evening.

The full force of the war slump came in the Stock Exchange last Friday and Saturday. Originally started by the Balkans crisis, the financial position of the Bourses grew graver every hour, until in Berlin and Paris there was something very like panic, stocks and shares being flung overboard regardless of anything else save the necessity of selling them, and for what they would realise. The certainty of an early rise in the Bank of England rate operated as an added cause of flatness, and not until Monday in this week was there any attempt made to rally prices. By then, however, the worst part of the slump had spent itself, and the bargain-hunters made their presence felt as they went about picking up cheap stock in this market and the other. Substantial recoveries occurred all round the Stock Exchange, where members again began to smile and to talk of cheerful things.

So far as the Electrical departments are concerned, the main alterations have occurred in the Home Railway section; while some of the Latin-Canadians show heavy falls. There has not been much selling, however, of other electrical stocks and shares, and it may be said that, up to now, the latter have escaped lightly enough from the demoralisation that has been felt in wide circles. Possibly the lowest quotations have not been plumbed even yet, for it is the invariable Stock Exchange rule that the lower prices go, the further will the fall be continued until powerful support comes to the rescue: just as the converse of the proposition is true, viz., that the higher quotations rise, the more they will mount, until some accident puts the extinguisher on them and sends them down again.

Looking first at the Home Railway movements, the most marked is that of a 5 point drop in Metropolitans, though this does not by any means indicate the lowest quotation reached. On Saturday morning stock changed hands at 51, from which there was a share rebound on the next business day to 54 bid. It is argued that at anything like the latter price—some 14 points below the best recently recorded—there is plenty of scope for improvement, seeing it is practically certain that big interests are endeavouring to obtain control of the company. Districts, from 41, fell away to 37, and the subsequent recovery has taken them up to 38¾, leaving a fall of 2 on the week. The liquidation shook Central Londons, the Ordinary stock at 74 and the Deferred at 72 being 4 and 5 points down respectively. East Londons tumbled to 8 before any

recovery set in, and the only stock in the market to show any resistance to the prevailing depression has been City and South London, which at 34 retains its previous advance, report being very insistent as to the company being taken over before long by one of its bigger brethren, of which the Midland is rumour's chief favourite.

London United Tramways Preference are 10s. lower, and the Debenture stock fell 1. Metropolitan Electric Trams went back to 23s. 9d., *ex* dividend, and the rumours which have recently been linking these two companies are decidedly subdued now. The Underground Electric Railway issues went down with the rest, the Income Bonds at 88, showing a drop of 3 points. British Electric Tractions gave way to a small extent. The slump, however, has not affected prior charge stocks, with the exception of Metropolitan Tramways 4½ per cent. Debenture, which is 1½ down.

The Latin-Canadian group, as already mentioned, suffered considerably in the general depression. Chief amongst the falls are those of 17 points in Sao Paulo Trams and 12 points in Rio Trams. The market is dealing now in certificates of deposit for both these Companies, but business in them has shrunk appreciably in consequence of the slump.

Montreal Light and Power shares went back 12, and Canadian Generals lost 5½ of their 7-point rise of last week. The Mexican group gave way all round, Mexico Trams losing 10 and Mexican Light and Power 6. British Columbia Electric stocks suffered severely, following upon their falls of a week ago. The satisfactory report from the Cape Electric Trams sufficed to raise the price a small fraction.

Amongst other traction issues, Anglo-Argentine Debentures weakened on the issue of the new stock. The underwriters of the latter expected to take up about 65 per cent. of their obligations. In the case of the Sao Paulo Electric 5 per cent. Debenture stock, which came out last week, the public took 22 per cent., and the underwriters were therefore left with 78 per cent., upon which the quotation fell to 2 discount; the stock looks cheap at this price, the yield working out to £5 7s. 6d. on the money. Victoria Falls Preference weakened to 18s. 9d., but the company's 5½ per cent. Debenture scrip keeps very steady at 95½. Para Electric Railways fell ⅜. Calcutta Trams at 6⅜ *ex* dividend are firm.

In the list of English Electricity Supply and Power descriptions, the principal alteration is a fall of £2 in City of London Ordinary, this, of course, being brought about by realisations on the part of the "bulls," a small speculative account still existing in the shares. Beyond this, the changes are insignificant. Brompton Ordinary and Preference enjoyed the distinction of being ¼ up in each case; and, even in the panicky markets at the end of last week, electric shares were exceptionally firm. Various rumours and reports as to something that is going to happen to make the market better continue to circulate; but in this connection we need only repeat our previous warning that too much importance must not be attached to statements which carry no official authority and which are in all probability premature.

The Telegraph market is steady, except in the few issues where anything like a "bull" account has been built up. West India and Panama shares dropped ¼, but the First Preference rose ⅛ to 10¾. Great Northern Telegraphs went back 15s., and the Anglo-American Telegraph Deferred fell ⅜. There was a sharp spurt in National Telephone Deferred the other day to 162; and though much of the rise was lost, an improvement of two points remains. The debate in the House of Commons on the Marconi contract has been studied with keen interest by the Stock Exchange; and the price of the shares, after touching 4¾, rallied to nearly 5. Monte Video Telephones gained 1/32 on the issue of a satisfactory report.

The feature in the Manufacturing market is the dulness of Castner-Kellner shares, which have fallen 3/16, although the Debenture stock is 2 points higher. British Westinghouse Preference fell ⅛, but Babcock & Wilcox are really 1/16 up, allowing for the dividend taken off last week. Dick, Kerr Preference, also *ex* dividend, have given way. Edison & Swan 4 per cent. Debenture put on a point. There are proposals in the air for a reorganisation of the company's capital account. The Brush Electrical Company has been sending round allotment letters of a new 6 per cent. Participating Debenture stock to its shareholders, some of whom evidently think that this form of issue implies a bonus, for the market has been besieged with inquiries as to what premium there is on the stock. It seems a pity that this method should have been adopted; and to those who are conversant with the condition of the market in the company's stocks and shares, it is scarcely necessary to say that there is no premium on the new issue.

Auckland Electric Tramways, Co., Ltd.—The directors report (according to an abstract in the *Times*) that the total revenue for the year ended June 30th amounted to £232,351. After providing for all expenses chargeable to revenue, including £17,322 for debenture and other interest, the rental and percentage of profits payable to the Auckland City Council amounting to £5,259, and setting aside £20,000 to the renewals and depreciating account, there is a surplus of £51,609, plus £7,147 brought forward, making £58,756. After placing £18,238 to reserve, making it £85,000, the directors recommend a further dividend on the ordinary shares at the rate of 11d. per share, tax free, for the half-year ended June 30th, making a total dividend of 1s. 6d. per share for the year, leaving £8,268 to be carried forward. It is proposed to increase the capital to £500,000 by the creation of 50,000 new preference shares of £1 each.

Bank Rate.—The Bank Rate was yesterday raised from 4 per cent. to 5 per cent.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Oct. 9	2,962	+ 153	19	30,726	+ 111	14·4	..
Ayr	„ 12	493	+ 67	21	9,122	+ 210	8	..
Birmingham Corp.	„ 5	22,766	+3,202	27	256,849	+63,063	57·17	..
Blackburn	„ 9	2,369	+ 35	28⅔	34,323	+ 254	14·62	..
Blackpool Corp.	„ 10	2,790	+ 540	..	58,287	+ 5,473	11·87	..
Blackpool-Fleetw'd	„ 12	1,323	+ 136	14	22,153	— 642	8	..
Bournemouth	„ 9	3,639	+ 302	27⅔	56,041	+ 1,726	21·95	..
Bradford	„ 5	11,074	+ 330	27	152,179	— 1,708	56	..
Brighton	„ 13	1,977	+ 58	28	31,837	— 1,061	9·5	..
Bristol	„ 11	14,693	+2,140	..	285,896	+22,959	30·5	..
Brit. Elec. Trac. Co.								
Airdrie	„ 4	657	+ 185	40	11,961	+ 3,204	3·65	..
Barnsley	„ 4	294	+ 9	„	7,139	— 262	..	..
Barrow	„ 4	761	+ 98	„	15,504	+ 3,041	5·37	..
Devonport	„ 4	965	— 12	„	21,693	+ 1,548	8·85	..
Gateshead	„ 4	2,202	+ 24	„	41,590	— 76	11·25	..
Gravesend	„ 4	465	+ 26	„	8,439	+ 3,375	6·5	..
Greenock	„ 4	1,681	+ 183	„	32,649	+ 3,375	7·25	..
Kidderminster	„ 4	258	+ 36	„	4,915	+ 57	..	..
‡Leamington	„ 4	334	+ 10	„	7,650	+ 343	..	..
Merthyr	„ 4	439	+ 26	„	8,052	— 378	2·9	..
Metropolitan	„ 4	17,745	— 238	„	353,364	— 736	22	..
Middleton	„ 4	692	+ 43	„	13,522	— 385	8·5	..
Mid. Joint Com'tee	„ 4	6,923	+ 636	„	130,970	+ 6,395	..	..
Oldham—Ashton	„ 4	1,245	+ 74	„	24,499	+ 1,462	9·13	..
Peterborough	„ 4	320	+ 6	„	5,574	+ 317	5·31	..
Potteries	„ 4	4,152	— 224	„	75,945	— 1,490	29	..
Rothesay	„ 4	427	— 175	„	10,120	+ 486	2·75	..
Southport	„ 4	593	+ 29	„	12,326	— 278	8·17	..
S. Metropolitan	„ 4	1,700	— 3	„	34,313	— 1,018	..	..
Swansea	„ 4	2,337	+ 51	„	46,253	+ 117	12·5	..
Tynemouth	„ 4	442	+ 22	„	10,344	— 971	3·75	..
Weston-s-Mare	„ 4	267	+ 10	„	6,532	— 1,298	3	..
‡Worcester	„ 4	622	+ 54	„	12,010	— 97	5·75	..
Wrexham	„ 4	234	+ 21	„	4,620	+ 527	..	..
Yorks. Wool. Dist.	„ 4	2,173	+ 73	„	43,326	+ 1,037	17	..
Miscellaneous	„ 4	479	+ 46	„	9,894	+ 143	..	..
Burnley	„ 13	3,338	+ 597	..	..	..	12·44	·7
Burton-on-Trent	„ 13	663	— 19	28	7,736	— 451	6·6	..
Bury	„ 13	2,661	+ 139	28	37,200	— 420	22·5	..
Cardiff	„ 5	4,992	+ 321	27	66,881	— 2,944	17·35	..
Chatham and Dist.	„ 8	1,826	+ 130	40	34,435	— 239	14·98	..
Cork	„ 10	964	+ 8	41	19,902	— 900	9·89	..
Croydon	„ 4	3,626	+ 123	27	49,934	— 1,135	11·6	..
Darlington	„ 12	453	+ 19	28	6,328	+ 50	4·87	..
Darwen	„ 11	570	+ 29	28	7,896	+ 184	4·36	..
Dover	„ 5	495	— 9	27	7,232	— 564	4·75	..
Dublin	„ 11	11,655	+ 424	..	89,595	— 8,983	54·25	..
East Ham	„ 12	2,064	+ 66	28	33,096	— 838	7·87	..
Exeter	..	..	..	..	..	..	..	..
Glasgow	„ 12	39,144	—1,391	..	359,040	— 7,684	98	..
Hastings	„ 10	1,909	+ 47	..	..	+ 2,809	19·3	..
Hull	„ 12	6,663	— 285	28	82,188	+ 445	13·5	—1
Ilkeston	„ 10	240	— 12	28	3,109	— 585	..	..
Ipswich	„ 12	855	+ 45	28	13,391	— 205	10·5	..
Kilmarnock	„ 12	322	+ 21	21	3,602	— 192	4·25	..
Lancashire United	„ 9	2,815	+ 153	41	55,339	— 165	39	..
Leeds	„ 12	15,767	+ 736	28	220,319	+ 6,908	112·7	..
Leicester	„ 12	5,321	+ 180	41	104,557	+ 3,264	20	..
Leith	„ 12	1,338	+ 133	21⅔	15,310	+ 290	8·72	..
Liverpool	„ 5	24,277	+ 454	39⅔	478,110	+20,511	117	1
‡L.C.C.	„ 2	82,487	—4,156	..	1,124,833	—59,095	141·1	—5
London United	„ 12	11,893	+ 150	..	260,211	—13,475	..	..
Lowestoft	„ 12	380	— 16	15	329	— 20	3·5	..
Manchester	„ 12	34,092	+1,475	28	473 044	+16,302	105	..
Newcastle	„ 12	8,920	+ 564	..	122,988	+ 1,492	31·3	..
Newport	„ 5	1,413	+ 66	27	19 215	— 638	7·25	..
Oldham	„ 6	4,072	+ 96	28	58,071	+ 3,033	23	..
Pontypridd	„ 12	870	+ 31	28	11,054	+ 674	5·5	..
Portsmouth	..	..	..	..	..	..	15·75	..
Preston	„ 2	1,605	+ 45	27	22,795	+ 1,007	10	..
Rotherham	„ 9	1,536	+ 174	27⅔	20,264	+ 1,346	12	..
Salford	„ 7	9 916	+ 292	27½	137,940	+ 3,057	41	..
Sheffield	„ 15	13,947	+ 992	..	192,559	+ 7,215	40	..
Southampton	„ 9	2,504	+ 146	27	35,993	— 54	11	..
Southend-on-Sea	„ 9	1,418	+ 280	28	25.100	+ 2,476	7	..
South Shields	„ 12	1,282	+ 119	28	18 178	+ 41	10·25	..
Tyneside	„ 9	961	+ 40	15	7,413	+ 724	11	..
Wallasey	„ 12	2,087	+ 1	27⅔	32,447	— 464	8·72	..
Walthamstow	„ 12	1,312	..	28	21,514	— 887	9	..
West Ham	„ 3	5 206	— 64	26⅓	71,119	— 2,611	16·45	1·2
Wolverhampton	„ 9	2,082	+ 118	28	28,546	+ 455	13·75	..
Cen. London Rly.	„ 12	10 889	+ 604	15	68,328	+ 1,201	6·78	·4
City & S. Lon. Rly.	„ 13	6 119	— 835	15	49,074	— 3,311	7·26	..
Dublin-Lucan Rly.	„ 11	313	+ 16	15	2,434	— 122	7	..
G.N. and City Rly.	„ 12	3,053	— 11	15	20,370	— 51	3·5	..
L'pool Overh'd Rly.	„ 13	3,145	+ 151	..	25,079	+ 1,952	6·6	..
Llandudno-Col. Bay	„ 11	497	+ 35	45·5	15,058	+ 655	6·5	..
Lond. Elec. Ry. Co.	„ 12	28,400	+ 910	15	186,075	+ 5,695	21·25	..
Mersey Railway	„ 12	4 349	+ 266	15	31,226	+ 3,332	4·5	..
Metropolitan Rly.	„ 13	84 718	+ 409	15	251,406	+ 5,866	25·75	..
Met. District Rly.	„ 12	26,640	+2,601	15	181,115	+16,129	25	..
Anglo-Argentine	„ 7	107,031	+8,089	..	2,082,024	+80,900	..	..
§Auckland	Aug. 30	18,602	+2,334	2	40,460	+ 8,506	24·1	..
Bombay (B.E.T.)	Sept. 20	6,340	+ 589	37	113,387	+ 5,706	..	..
§Brisbane	Sept.	22,700	+1,560	9	181,094	— 3,556	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Oct. 12	9,127	+ 2,553	..	..	+19,222	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Sept.	8,251	..	9	28,788	..	20·5	..
§Lisbon	..	..	..	..	..	..	..	..
Madras	Sept. 30	1,587	+ 125	..	29,942	+ 3,291	14·7	2
§Montevideo	Sept.	27.711	+4,465	11	317,818	+44,299	..	..
Perth (W.A.)	Oct. 11	3 907	+ 486	..	75,223	+10,866	29	..

* Compared with the corresponding period of 1911. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Oct. 15th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	* 10	5½	5†	9⅜ — 10⅜	..	5 2 4
Do. 4½ % Pref.	10	4½	4½	8⅞ — 9⅜	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10¼ — 10⅝	..	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	98 —100	+ ½	4 10 0
Brompton & Kensington, Ord.	5	10	9†	9 — 9⅛	+ ¼	5 5 3
Do. 7 % Cum. Pref.	5	7	7	8¼— 8⅝	..	3 17 9
Central Electric Supply, 4 % Guar. Deb.	100	4	4	97 —100	..	4 0 0
Charing Cross, West End & City	5	5	5†	4⅞— 5⅛	..	4 18 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜— 4⅝	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	8⅜— 4⅛	..	5 6 0
Do. Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Chelsea, Ord.	5	5	4†	4½— 5	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	98 —101	..	4 9 1
City of London, Ord.	10	8	6†	15 — 17	— 1	4 14 2
Do. 6 % Cum. Pref.	10	6	6	12½— 14	..	4 5 9
Do. 5 % Deb.	Stock	5	5	118 —122	..	4 2 0
Do. 4½ % Second Deb.	100	4½	4½	99 —102	..	4 8 3
County of London, Ord.	10	6	4†	11½— 12	..	5 0 0
Do. 6 % Pref.	10	6	6	11⅝— 12⅜	..	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	106 —108	..	4 3 4
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 8 3
Edmundson's, Ord.	5	Nil	..	7/16— 11/16	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	5/16— 8/16	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4⅝— 5½	..	5 17 1
Do. 5 % Cum. Pref.	5	5	5	4⅝— 5⅜	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	92 — 95	..	4 14 9
Hove	5	9	8†	7⅜— 7⅝ xd	..	5 14 3
Kensington & Knightsbridge, Ord	5	9	8†	7⅞— 8	..	5 12 6
Do. 4 % Deb.	Stock	4	4	90 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	78 — 82	..	5 9 9
London Electric, Ord.	3	2½	..	1⅝— 2⅛	..	3 10 8
Do. 6 % Pref.	5	6	6	4½— 5¼	..	5 14 3
Do. 4 % First Mort. Deb.	Stock	4	4	90 — 93	..	4 6 0
Metropolitan	5	4	4†	3⅝— 4⅛	..	4 17 0
Do. 4½ % Cum. Pref.	5	4½	4½	4¼— 4⅝	..	4 17 4
Do. 4½ % First Mort. Deb.	Stock	4½	4½	99 —102	..	4 8 3
Do. 3½ % Mort. Deb.	Stock	3½	3½	86 — 88	..	3 19 7
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	97½— 99½	..	4 10 6
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	4⅜— 4⅞	..	5 2 7
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 —104	..	4 16 2
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	10 — 11	..	5 9 1
Oxford	5	7½	6†	6 — 6½	..	5 11 6
St. James' and Pall Mall, Ord.	5	10	10†	8½— 9⅛	..	5 5 3
Do. 7 % Pref.	5	7	7	6½— 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 88	..	3 19 7
Smithfield Markets, Ord.	5	2	..	1⅜— 1⅞	..	..
South London, Ord.	4	5	..	3 — 3¼	..	5 14 3
Do. 5 % First Mort. Deb.	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1⅛— 1⅛	..	5 12 0
Do. 4½ % First Deb. Stock	100	4½	4½	96 — 99	..	4 11 0
Urban, Ord.	£3	Nil	..	¼— ⅜	..	..
Do. 5 % Cum. Pref.	5	2	†	2⅛— 3⅛	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84½— 88½	..	5 1 8
Westminster, Ord.	5	10	9†	8⅝— 9⅛	..	5 8 1
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅜	..	4 3 0

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5¼— 5⅜	..	5 4 4
Calcutta, Ord.	5	8½	..	7⅜— 7⅝	— ⅛	5 8 0
Do. 5 % Pref.	5	5	5	4 13/16— 5 3/16	..	4 16 5
Calgary Power, 1st Mort. Bds.	100	5	5	93½— 95½	—1½	5 4 9
Canadian Gen. El. Com.	$100	7	7	115 —119	—5½	5 17 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	8	..	⅞— 1	..	3 0 0
Do. 5 % Deb.	100	5	5	94 — 97	—1	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	92 — 94	..	6 7 8
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	83 — 86	+ 2	5 16 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	95½— 97½	..	5 2 7
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/16— 5/16	..	Nil
Do. 6 % Pref.	1	6	6	1 1/16— 1 1/8 xd	..	8 14 6
Kaministiquia Power, 5% G. Bs.	$500	5	5	104 —106	..	4 14 4
Madras, Ord.	£	Nil	..	1½— 2	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102 —105	..	4 15 3
Mexican El. Lt., 5 % 1st M. Bds.	$100	5	5	87 — 89	..	5 12 4
Mexican Lt. & Power, Common	$100	4	4†	86 — 90 xd	—6	4 9 0
Do. 7 % Cum. Pref.	$100	7	7	103 —106 xd	—1	6 12 1
Do. 5 % 1st Mort. Gold Bds.	..	5	5	94 — 96	—½	5 4 2
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	85 — 88	— 1	5 13 8
Montreal, Lt., H. and Power	$100	8	9†	232 —237	—12	3 16 4
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5a	39 — 42	..	..
River Plate, Ord.	Stock	10	..	240 —250	..	4 0 0
Do. 6 % Non-Cum. Pref.	Do.	6	6	109 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	102 —104	..	4 16 2
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	98 —100	..	4 10 0
Shawinigan Water, Capital	$100	5	5	140 —144	—8	3 9 5
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	— ½	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	103½—105½	..	4 5 4
Toronto Power, 4½ % Deb.	Do.	4½	4½	96½— 98½ xd	— ¾	4 11 5
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	94 — 97	..	5 3 1
Victoria Falls Power, Pref.	1	11¼d.	17/8d.	32/32— 34/32	—1/16	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	103 —105	..	5 14 3

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	4	..	7½— 7⅞	..	5 3 3
Do. 5 % Deb. Red.	Stock	5	5†	96 — 98	..	5 2 0
American Telep. & Teleg., Cap.	$100	8	8†	146 —148	—1	5 8 1
Do. Collat. Trust	$1000	4	4	93½— 95½	..	4 3 9
Anglo-American Telegraph	Stock	8	8	67 — 69 xd	..	4 7 0
Do. 6 % Pref.	Do.	6	6	111½—112½xd	— ⅜	5 6 8
Do. Def.	Do.	80/-	..	26 — 26½	— ⅜	5 14 3
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	5	7	8	7⅜— 7⅞	..	4 8 11
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	82½— 84½	..	4 14 8
Cuba Telegraph	10	6	..	9½— 10½	..	5 14 3
Do. 10 % Pref.	10	10	10	16½— 17½	..	5 14 3
Direct Spanish Telegraph, Ord.	5	4	4†	3 — 3⅜	..	5 14 4
Do. 10 % Cum. Pref.	5	10	10	6¾— 7	..	7 2 10
Direct United States Cable	10	5	4	7⅜— 7⅝	..	6 7 0
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98 —100	..	4 10 0
Eastern Telegraph, Ord. Stock	Stock	7	7†	129 —132 xd	..	5 6 1
Do. 3½ % Pref. Stock	Do.	3½	3½	77 — 79 xd	..	4 8 1
Do. 4 % Mort. Deb.	Do.	4	4	99½—101½	..	3 18 10
Eastern Extension	10	7	7†	13 — 13½	..	5 3 8
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	98 —101	..	3 19 3
Globe Telegraph and Trust	10	6	6†	11 — 11½	..	5 4 4
Do. 6 % Pref.	10	6	6	12⅜— 13¼	..	4 10 7
Great Northern Telegraph	10	18	18	28 — 29	—⅜	6 4 2
Indo-European Telegraph	25	13	..	57 — 59	..	5 3 5
Mackay Companies Common	$100	5	5†	86 — 89	—1	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	69 — 73	+1½	5 9 7
Marconi's Wireless Telegraph	1	20	..	4⅛— 4⅜	—⅛	4 1 1
Do. 7 % Cum. Partic. Pref.	1	17	..	4⅛— 4⅜	— ⅛	3 17 8
Monte Video Telephone, Ord.	1	6	..	1⅞— 1 3/32	..	5 1 1
Do. 5 % Pref.	1	5	5	1 3/32— 1 5/32	..	5 6 8
National Telephone Def.	Stock	6	..	157½—159½	+2	..
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100½—101½	— ½	4 8 8
Oriental Telep. and Elec.	1	8	..	1⅜— 1⅝	..	4 5 4
Do. 6 % Cum. Pref.	1	6	6	1 3/32— 1 5/32	..	4 18 5
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 9 0
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100	..	4 0 0
Reuter's	10	10	10†	10⅜— 11⅛xd	— 1/16	8 17 10
Submarine Cables Trust	Cert.	6	6	126 —129 xd	..	4 13 0
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99½—101½	..	4 8 8
United River Plate Telephone	5	8	..	7 1/16— 7 1/8	— 1/16	5 4 1
Do. 5 % Cum. Pref.	5	5	5	6⅜— 6⅝	..	4 8 11
West Coast of America	2½	2½	..	1 13/32— 1 15/32	..	3 18 5
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	10	2½	..	3⅛— 3⅜	— 1/16	..
Do. 6 % Cum. 1st Pref.	10	6	6	10¾— 11	+ ⅛	5 9 1
Do. 6 % Cum. 2nd Pref.	10	6	6	9¾— 10¼	..	6 17 0
Do. 5 % Debs.	100	5	5	101 —103	..	4 17 1
Western Telegraph, Ltd.	10	7	7†	13⅜— 13⅞	..	5 1 0
Do. 4 % Deb.	Stock	4	4	96½— 98½	..	4 1 3
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	98½—101½ xd	..	4 8 8

* Unless otherwise stated, all shares are fully paid. *a* Paid in deferred interest warrants. † Interim Dividend. ‡ 3s. in Funded Dividend Certs.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for		Closing Quotations Oct. 15th.	Rise + or Fall —	Present Yield p.c.
	*	1911.	1912.			£ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	⅜ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	11/16 — ¾	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	76 — 81	..	5 11 1
Brit. Elec. Trac., 6 % Pref.	100	..	..	12 — 14	..	..
Do. Do. Deferred	100	..	..	6 — 8	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	89 — 92	..	6 10 5
Do. 7 % Non-Cum. Pr'f.	100	..	..	38 — 41	—1	..
Do. 5 % Perp. Deb.	100	5	5	94 — 97 xd	—1	5 3 1
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 83	..	5 7 2
Central London Railway, Ord.	100	8	8†	73 — 75	—4	4 0 0
Do. Pref.	100	4	4	84 — 86	..	4 13 0
Do. Def.	100	2	..	71 — 73	—5	2 14 10
Do. 4 % Deb.	100	4	4	100 —102	..	3 18 5
City & South London, Ord.	100	1⅝	1½†	42½ — 43½	..	3 3 2
Do. 5 % Pref., 1891	100	5	5	107 —109	..	4 11 9
Do. Do. 1896	100	5	5	105 —107	..	4 13 6
Do. Do. 1901	100	5	5	105 —107	..	4 13 6
Do. Do. 1903	100	5	5	104 —106	..	4 14 4
Do. 4 % Deb.	100	4	4	99 —101	..	3 19 3
Dublin United Trams, 6 % Pref.	10	6	6	12 — 13	..	4 12 4
Great Northern & City, Pr'f. Ord	10	Nil	Nil	1⅞ — 2⅛	..	Nil
Hastings Trams, 6 % Pref.	1	6	6†	⅞ — 1	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	69 — 74	..	6 1 7
Isle of Thanet Trams, 5 % Pref.	5	2½	..	2¼ — 2⅜	..	4 11 0
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	81 — 83	..	6 0 6
London Elec. Railw'ys, 4 % Deb.	100	4	4	95 — 97	..	4 2 6
London United Trams, 5 % Pref.	10	Nil	..	4⅜ — 5⅛	—⅜	..
Do. 4 % Deb.	100	4	4	72 — 76	—1	5 5 3

NAME.	Stock or Share.	Dividends for		Closing Quotations Oct. 15th.	Rise + or Fall —	Present Yield p.c.
	*	1911.	1912.			£ s. d.
Metropolitan Railway Consol.	100	1⅞	1½†	54½ — 55	—4½	2 19 1
Do. Surplus Lands	100	2⅝	2⅝†	64 — 66	..	4 3 4
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	85 — 87	..	4 0 ..
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	Nil	38½ — 39	—2	Nil
Do. 6 % Deb.	100	6	6	141 —143	..	4 4 0
Do. 4 % Deb.	100	4	4	94 — 96	—½	4 3 4
Do. 4 % Prior Lien	100	4	4	99 —101	..	3 19 3
Do. 4½ % First Pref.	100	4½	4½	88 — 91	..	4 19 0
Do. 3½ % Gtd.	100	3½	3½	75 — 77	..	4 11 0
Metropolitan Elec. Trams, Ord.	1	6	5†	1⅛ — 1⅜ xd	— 1/16	4 16 0
Do. Def.	1	Nil	..	1/16 — 1/8	..	Nil
Do. 5 % Pref.	1	5	5	13/16 — 1	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	96 — 98	—1½	4 11 10
Do. 5 % Deb.	100	5	5	97½—100½	..	4 19 6
Potteries, Ord.	1	2½	..	5/16 — 7/16	..	..
Do. 5 % Pref.	1	5	5	13/16 — 15/16	..	6 19 0
Do. 4½ % Deb.	100	4½	4½	87 — 90	..	5 0 0
South Metro. Trams, 6 % Pref.	1	6	..	1⅛ — 1⅜	..	7 7 8
Do. 4 % Deb.	100	4	4	70 — 75	..	5 6 8
Underground Elec. Railways	10	..	..	3½ — 4	— ⅛	Nil
Do. "A"	1/-	..	..	29/32 — 31/32	— 1/16	..
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	1½	£2	87 — 89	—3	..
Yorkshire (West Riding), Ord.	5	Nil	..	1 — 1⅛	..	Nil
Do. 6 % Pref.	5	3	..	2½ — 3½	..	4 9 0
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	£½	4⅞ — 5⅛	..	5 7 4
Do. 2nd Pref.	5	5½	£½	4⅛ — 5⅛	..	5 3 6
Do. 4 % Deb.	100	4	4	93½ — 95	..	4 4 3
Do. 4½ % Deb.	100	4½	4½	99 —101	—1	4 9 1
Do. 5 % Deb.	100	5	5	99 —101	—1	4 19 0
Auckland Trams, 5 % Deb.	100	5	5	103½—105½	..	4 14 9
Bombay Elec. S. & Trams, Pref.	10	6	6	11½ — 12	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	97½ — 99½	+ ½	4 10 6
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brisbane Trams Invt., Ord.	5	8	..	7¼ — 7⅝	..	5 3 3
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	100½—103½	..	4 7 0
B. Columbia Elec. Rly., Def.	100	8	..	141 —146	—3	5 9 7
Do. Pref. Ord.	100	6	6	112 —116	—4½	5 8 5
Do. 5 % Pref.	100	5	5	104 —107	—1	4 13 6
Do. 4½ % 1st Mort. Deb.	40	4½	4½	99½—102½	..	4 7 10
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —106	..	4 5 0
Do. 4½ % Con. Deb.	100	4½	4½	101 —103	..	4 2 6
Calcutta Trams, Ord.	5	7	5†	6¼ — 6⅝ xd	..	5 5 8
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3
Cape Electric Trams	1	2½	..	2¼ — 2⅝	+ 1/32	..
City Buenos Aires Trams (1904)	5	5	5†	6¼ — 6⅝ xd	..	4 6 11
Do. 4 % Deb.	100	5	5	99 —102	..	4 18 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 — 99	..	5 1 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	1/16 — 3/32	..	Nil
Do. 5 % A Deb.	100	5	5	86 — 91	..	5 10 0
Do. 6 % B Deb.	100	6	3	35 — 43	..	..

La Plata Elec. Trms, Ord.	1	Nil	..	3/32 — 1/8	..	..
Do. Pref.	1	6	..	3/4 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	..	1 1/16 — 1 1/16	..	4 11 5
Do. 6 % Pref.	1	6	6	1 — 1½	..	4 16 0
Do. 5 % Deb.	100	5	5	93 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	100 —102	..	4 18 0
Manaos Trams & Lt., 1st Deb.	100	5	5	92 — 95	..	5 5 3
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½—102½	..	4 17 7
Mexico Trams Com.	$100	7	7†	115 —118 xd	—10½	5 18 8
Do. Gen. Con. 5 % Bonds	..	5	5	96 — 98	—2	5 2 0
Do. 6 % Bonds	100	6	6	99 —101	—2½	5 18 10
Para Elec. Rlys. & Lt., Ord.	5	10	10†	7½ — 7⅝	— 1/16	6 11 2
Do. 6 % Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	100½—102½	..	4 17 6
Perth (W.A.) Elec. Tr., Ord.	1	5	5†	1⅛ — 1⅜	..	1 16 4
Do. 5 % 1st. Deb.	100	5	5	99 —102	..	4 18 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5½ — 5⅝	..	5 4 4
Do. 4½ % 1st Deb.	100	4½	4½	97 — 99	..	4 11 0
Rio de Janeiro Trams	$100	5	5†	146 —151	—12	3 6 3
Do. 1st Mort. 5 % Bonds	..	5	5	100 —102	—1½	4 18 0
Do. 5 % Mort. Bonds	100	5	5	95½— 97½	—1½	5 2 7
Sao Paulo Tram, Lt. and P.	$100	10	10†	258 —268	—17	3 14 8
Do. 5 % 1st Deb.	$500	5	5	102 —104	—2	4 14 4
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96 — 98	..	5 2 0
Un. Elec. Trams Monte Video	5	7	..	5⅜ — 6⅛	..	5 14 3
Do. 6 % Pref.	5	6	..	4⅝ — 5⅜	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	101 —104	..	4 16 2
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	101 —103	— ½	4 7 5

MANUFACTURING COMPANIES.

Aron, Ord.	1	6	..	⅜ — ⅝	..	8 0 0
Do. 6 % Pref.	1	6	6	1⅛ — 1⅜	..	7 7 8
Babcock & Wilcox	1	28	14†	3⅝ — 3⅞ xd	+ 1/16	4 2 10
Do. Pref.	1	6	6	1 1/16 — 1 1/16 xd	..	3 16 10
British Aluminium, Ord.	1	Nil	..	⅜ — ⅝	..	..
Do. 6 % Cum. Pref.	1	Nil	..	⅝ — ¾	..	..
Do. 5 % Prior Lien Debs.	100	5	5	93 — 96	..	5 4 2
Do. Deb. Stk.	100	5	5	85 — 88	..	5 13 8
B.I. & Helsby Cables	5	10	8†	7¾ — 8	..	6 5 0
Do. Pref.	5	6	6	5¾ — 6⅛	..	4 14 1
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 96	..	4 13 9
British Westinghouse, Pref.	8	Nil	Nil	⅛ — ⅜	— 1/16	Nil
Do. Deb.	100	4	4	60 — 63	..	6 7 0
Do. 6 % Prior Lien	100	6	6	99 —102	..	5 17 8
Browett, Lindley, Ord.	1	..	..	2/- —3/-	..	Nil
Do. Pref.	1	..	..	4/6 —5/-	..	Nil
Brush, 7 % Pref.	2	Nil	Nil	0 — ½	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	75 — 80	..	6 5 0
Do. 4½ % Deb.	100	4½	4½	50 — 55	..	8 3 8
Do. 4½ % Second Deb.	100	4½	4½	35 — 40	..	11 5 0
Callender's Cable	5	15	..	10½ — 11	..	6 16 4
Do. Pref.	5	5	5	4⅜ — 5⅛	..	4 17 7
Do. Deb.	100	4½	4½	99½—101½	..	4 8 8
Castner-Kellner	1	20	15†	3⅝ — 3¾	— 1/16	5 6 8
Do. Deb.	100	4½	4½	105 —108	+2	4 3 4

Crompton & Co.	3	Nil	..	⅛ — ⅜	..	Nil
Do. Deb.	100	5	5	56 — 66	..	7 11 6
Dick, Kerr	1	5	Nil	⅜ — ⅝	..	..
Do. Pref.	1	6	6	⅝ — ⅞ xd	— 1/32	6 17 2
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £8 paid	5	Nil	..	⅛ — ⅜	..	Nil
Do. fully paid	5	Nil	..	⅛ — 2⅛	..	Nil
Do. 4 % Deb.	100	4	4	65 — 69	+1	5 16 0
Do. 5 % Second Deb.	100	5	5	72 — 75	..	6 13 4
Electric Construction	2	2½	3⅜	⅜ — 1	..	7 10 0
Do. Pref.	2	7	7	1½ — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7⅞ — 8	..	8 5 8
Do. Deb.	100	5	5	92 — 94	..	5 4 2
General Electric, Pref.	10	5	5	10 — 11	..	..
Do. Deb.	100	4	4	90 — 95	..	4 4 3
Henley's, Ord.	5	17	5†	12½ — 13	..	5 15 5
Do. Pref.	5	4½	4½	4⅜ — 5⅛	..	4 7 10
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
India-Rubber, G. & T.	10	..	..	11½ — 12½	..	..
Do. Pref.	10	5	5	9½ — 10½	..	4 17 7
Telegraph Construction	12	17½	5†	34 — 36	..	6 13
Do. Deb.	100	4	4	98 —100	..	4 0
Willans & Robinson	1	Nil	..	⅜ — ½	..	Nil
Do. Pref.	5	Nil	..	⅜ — 1	..	Nil
Do. Deb.	100	4	4	58 — 60	..	6 13

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 4 per cent. August 29th, 1912.

RECENT DEVELOPMENTS IN WIRELESS TELEGRAPHY: WITH SPECIAL REFERENCE TO SHIP INSTALLATIONS.

The following notes deal with the more important views and statements presented by Director H. Bredow, in a communication of exceptional interest and value, to the 1912 *Jahrbuch der Schiffbautechniker Gesellschaft*. It is hardly necessary to state that the author is very strongly biased in favour of the Telefunken system of radiotelegraphy, and, indeed, it would be neither wise nor just to reproduce *in extenso* some of the sections of the original dealing with general matters of policy and claims. The technical features of the article present so much valuable matter—which is, moreover, not affected by the omissions made for the above reason—that no further justification need be sought for the present abstract.

Recent development in the German radiotelegraphic field has been very rapid, and the Telefunken Co. now claims to have a greater number of stations in operation than are worked on the Marconi system. During the year 1911, 252 ship, 66 land and 72 portable stations (total, 390) were installed on the tuned-spark system, whereas, during the 10 years ending 1910, only 1,300 stations had been equipped on any system. Among the chief of the advantages attached to the tuned-spark system of working may be mentioned longer trains of purer waves, freedom from interference by "foreign" or "accidental" signals, greater range per kilowatt of radiated power and *greatly increased energy efficiency*.

Whereas the old Telefunken, Marconi and Poulsen systems enabled the radiation of 15—25 per cent. of the energy fed into the primary transmitting circuit, the new Telefunken system claims a radiation efficiency varying, according to circumstances detailed below, from 50—80 per cent. Fig. 1 shows that, as a result of

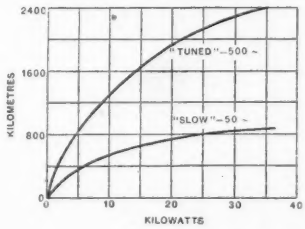


Fig. 1.

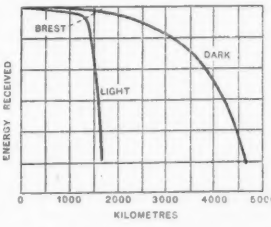


Fig. 2.

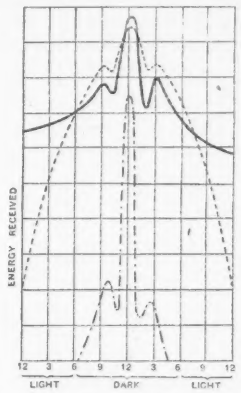
this increased efficiency, 35 KW. now suffices for communication over 2,400 km., as against 1,000 km. with the older systems. All the Telefunken stations are rated by the amount of power *radiated* from the aerial (which amount is guaranteed in each case). Although this is the most rational rating system, stations working on other systems are generally rated by the power *input* required—a distinction which it is the more important to remember in view of the great difference in efficiency between the equipments (10-80 per cent.).*

In choosing between two rival equipments, the one with the higher aerial efficiency should be selected, even though the price and the power input and nominal range be the same in the two cases. The higher radiation efficiency permits a higher margin of safety, and the loose coupling with which it is possible to work in the tuned spark system enables the obliteration of "atmospherics," while the pure tone of the telephone note is easily selected from "foreign" signals which it may be impossible to eliminate.

Range of Working.—There is no theoretical limit to the distance over which communication can be established, but the energy which can be radiated from any particular aerial, and hence the range of transmission from the latter, is limited by the capacity of the antennæ. The original Nauen aerial had a capacity area of 31,400 sq. m., and, with a maximum elevation of 100 m., averaged 80 m. above ground, yet its maximum absorption was 35-40 KW., and, on endeavouring to increase this amount, excessive brush discharge commenced, and ultimately the insulation broke down. To enable direct communication between Germany and her Colonies would require the erection of towers approximating to the dimensions of the Eiffel Tower, carrying antennæ capable of radiating 100 KW. of high frequency oscillations. The "purer" the latter the greater the effective range per kilowatt radiated. The wave form of the radiated oscillations is largely affected by the shape of the aerial, and for distances of 10,000 km. and greater distances, the magnitude and design of the aerial certainly become the controlling factor.

The wave length employed and the absorption encountered are the chief other influences affecting the range of communication. The absorption varies with the nature, and state of the earth's surface and of the atmosphere, and is especially increased by sunlight. The effective range may be two or three times as great by night as by day. For every distance, time, direction and circumstance of transmission, there is a "best" wave length which should be determined by trial and adopted as standard (as far, of course, as is practicable—the "best" wave length is continually varying and for this reason, as well as for obvious practical reasons, compromise becomes necessary). By varying the wave length the effect of absorption can, within limits, be overcome.*

Fig. 2 illustrates the extraordinary difference between the night and day transmission ranges under conditions otherwise identical. Telegrams were despatched every morning and afternoon from Nauen, using a 200-m. wave and constant radiated energy throughout, to a steamer leaving Hamburg. Until the steamer reached Brest, the land intervening between it and Nauen was flat; subsequently, mountains had also to be traversed and the rate of decrease of the received energy suddenly increased as a result of the additional absorption now experienced *en route*. It is remarkable, however, how very much more pronounced the effect of the mountains was by day than by night. Fig. 3 shows precisely the same phenomena in a slightly different manner. The upper curve shows the relative strength of messages received from Barcelona at various hours (the distance being 500 km., partly over high mountains, and the transmitting conditions being constant). The depressions in the curve at dusk and dawn are very striking. The difference between curves (1) and (2) is attributable to the different aerials and transmitting



—— Madrid from Barcelona; - - - - Barcelona from Madrid
— · — · Barcelona from Ceuta (Morocco).

Fig. 3.

energy at the two stations. It should be clearly understood that these curves are relative rather than absolute. The personal equation in this matter is of such importance that it is very difficult to make absolute measurements. A good means of estimating the intensity of received signals, failing the use of a suitable thermo-galvanometer, is to connect a variable resistance in parallel with the receiving telephone; the value of the resistance when the signals just become inaudible forms a useful practical criterion of the intensity of reception, detector delicacy, and so on.

The effective range of a station being defined as the greatest distance over which commercial traffic can be safely conducted, it naturally follows that the "range" of a land station is less with regard to a ship than with regard to a land station with an aerial more nearly equal to its own. Land and coast stations have usually very large and widespread aerials, whereas those on shipboard are necessarily very limited in extent, and are often adversely affected by the surrounding metal (steel masts, &c.). This difference is specially serious when the ship is receiving from a station radiating 4,000-6,000 m. waves, and, in spite of the technical convenience of the latter for radiating large quantities of energy, a shorter wave usually extends the range of communication with ships.

Though the range of transmission is, theoretically, unlimited, mechanical considerations limit the size of aerial structure which can practically be erected. The generation of oscillating energy in suitable form and bulk, offers no great difficulty. Small stations (with a day range of, say, 50 km.) need about 100 watts oscillating energy in the aerial; the largest stations at present in operation (Nauen and the Clifden-Glace Bay stations) require 30-40 KW. each, but the Telefunken Co. has recently built a 100-KW. spark sender, and the A.E.G. has built 100-KW. and larger machines on the Goldschmidt principle.† The Nauen tower (the height of which was doubled last year—the tower then being 200 m. high, and, next to the Eiffel Tower (300 m.), the highest structure on earth), can now radiate over 100 KW. of high frequency oscillations, the power house being equipped with two generators, each of 100 KW. capacity and working one on the tuned spark and one on the Goldschmidt principle. The double equipment gives security of working and exceptional facilities for research, and the results which have already been obtained with the Goldschmidt alternator prove beyond doubt that the future, in this field, belongs to the dynamo-electric high-frequency generator, even for the greatest power requirements.

As shown in fig. 4, the extension of the Nauen aerial consisted in extending the main tower 100 m. vertically, and in extending the sweep of the aerial wires, which are now strained out to 18 wooden

* For a discussion involving identical principles, but in connection with lamp ratings, see Electrical Review, Vol. LXVI, page 76.

* For latest investigations on relation between distance and strength of received signals see Electrical Review abstract, Vol. 70, p. 384, in the equations of which, however, l represents *not* the wave length but the base of Napierian logarithms.

† For full particulars of the theory of this generator, which supplies large quantities of energy at a frequency suitable for direct application in wireless circuits, see Electrical Review November 24th, 1911, page 880, *et seq.*

towers 30 m. high, and spaced round a circle of 400 m. radius. The length of the aerial radii has been doubled (and is now 200 m.), and the effective capacity area of the network approximates 120,000 sq. m.

The extension of the main tower is, in itself, an engineering feat, the upper 100 m. being free to rock on the under part (but, of course, under the control of the guy ropes). The flexibility of the structure is thus greatly enhanced, and even during its erection, when but imperfectly supported, the tower withstood several severe storms.* The extensions occupied about four months, and,

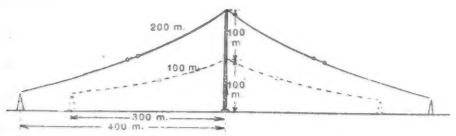


Fig. 4.

to save time, the alterations to the main foundations and foot insulation were carried on simultaneously with the upper building. The tower was lifted hydraulically and supported by trestles for some weeks, when, the tower being already 170 m. high, it was lowered on to the newly-completed foundations.

Existing and Prospective Stations.—The longest route over which regular commercial radiotelegraphic traffic is at present practised is the 3,100-km. trans-Atlantic route between Clifden and Glace Bay. The Nauen station has a greater range than either of the latter, but works over no definite route in conjunction with a sister station. Experiments conducted last year between Nauen and the Hamburg-American steamship *Bosnia*, showed that the range of the former

TABLE I.—International Returns, July, 1911.

	Number of stations.		
	Warships.	Merchant vessels.	Land.
Austria-Hungary	37	5	3
Belgium	—	20	1
Brazil	25	—	11
Canada...	—	9	32
Chile	9	—	4
Denmark	13	4	8
France...	140	38	18
Germany	98*	156	16
Great Britain	220	296	40
Greece	13	3	—
Holland	18	33	6
Italy	87	48	19
Japan	No returns	20	6
Monaco	—	1	—
Norway	13	5	4
Portugal	5	2 (Azores)	5
Roumania	—	5	1
Russia	No returns	2	17
Sweden	27	—	2
Spain	7	26	2
Uruguay	1	—	2
Totals ...	713	673	197

* Excluding torpedo-boats.

when using about 60 per cent. of the power required by the Marconi trans-Atlantic stations, and when messages were received by the comparatively tiny aerial of the *Bosnia*, was certainly not less than 5,000 km.† by night and 1,700 km. by day. Had the station been communicating with one having a large aerial network, the daylight range of communication would have been very much greater.

Every civilised country has now a more or less important network of land radiotelegraphic stations in operation; ‡ no new warship is without a powerful installation, and it is not too much to hope that in a few years' time, every large merchant and passenger vessel will have a receiving and transmitting equipment, and every vessel, however small, at least an equipment suitable for the reception of time signal and storm warnings.

Every important State, with the exception of the U.S.A. and Italy, has ratified the findings of the Berlin Radio Congress, and, as a result, the installation of coastal stations and the facilities for intercommunication with shipping have developed very rapidly. Ships bound for the East have no difficulty in communicating with land stations, until the Red Sea is entered (see Table IV), but thence, for a long distance, facilities are very poor, for the Italian stations are not permitted unlimited communication with all vessels,* and the English stations in this neighbourhood and on the Indian coast are few in number, and chiefly reserved for official use. The Dutch Government has been very active in the East, and, in addition to the completed station at Sabang (N. Sumatra), is now erecting stations in Java and Borneo. The Philippines and the Chinese coast offer some facilities for radio-communication with ships, and Japan is completing a very important series of coast stations on the Telefunken system. Important stations are in operation at Melbourne and Sydney, and a number of others will soon be completed in Australia.

There are no stations for commercial traffic, in the true sense of the expression, on the coast of the U.S.A. The State stations are reserved for military and naval use, and the many private stations are permitted to communicate with whom they will, and hence usually confine their traffic to ships using their own system, or with whom special contracts have been arranged. To improve these conditions, an important Telefunken station has been erected in New York. Central America is more favourably situated,

TABLE II.—Traffic Route and Type of German Mercantile Vessels Equipped with Wireless Apparatus.

Sailing route.	Passenger.	Passenger and cargo.	Cargo and various.
Baltic and North Sea ...	4	8	15
North America	4	57	—
Central America	—	4	—
South America (East) ...	—	18	—
South America (West) ...	—	11	6
Mediterranean	—	—	4
East and West Africa ...	—	16	—
East Asia	—	9	—
Australia	—	6	—
Miscellaneous	—	—	1
Totals	8	129	26

and on the east coast alone of South America there are 66 coast stations, 49 of which operate on the Telefunken system. Vessels approaching Brazil from the U.S.A. communicate with Para, and those from Europe communicate chiefly with Fernando Noronha.

TABLE III.—Record Ranges: Telefunken Ship Sets.

Steamer.	Communicating with	Range; km.	Nature of intervening land or sea.
Cap Blanco ...	*Corcorado*	2,440	Open sea.
Ditto ...	Heligoland	3,300	50 % land; straight over Spain.
Kleist... ..	Marseilles	2,490	Open sea.
Eleonore Woermann	*Lucie Woermann*	3,700	75 % land; *via* C. Palmas-Teneriffe.
Lucie Woermann	Marseilles	3,300	50 % land; over W. African mountains.
Kaiser Wilhelm II	Norddeich	2,833	Open sea.
Neckar	Norddeich	3,234	Open sea.

Few wireless facilities are available in the South Seas and the Pacific Ocean.† New Zealand is erecting modern stations and the English and German Governments are erecting various stations on their islands in this area, but on the western mainland coasts of South and North America there are few stations conducting regular commercial traffic.

The increase in the number of mercantile ship installations is essentially dependent on the increase in the number of coast stations

TABLE IV.—Communication to and from "Kleist" by Night.

Position of the *Kleist*.	Intercommunication effected with	Distance between stations: km.
Off Cuxhaven	Algiers	1,970
Off Lisbon	Marseilles	1,350
Between Almeria & Mellila	N. Foreland	1,920
Off Algiers	N. Foreland	1,870
N. of Sicily	Scheveningen	1,675*
N. of Crete	Algiers	1,810
N. of Alexandria	Marseilles	2,490

* Note that this route involved transmission across the Alps,

with which they can exchange messages. A comparatively small number of coast stations could transmit messages to ships in all the seas of the world, but the comparatively small transmission range which, at present, appears inevitable so far as ship installations are

* Since writing the above the tower has been completely demolished (March, 1912) as the result of breakage of the guy ropes holding the upper part of the tower. A different and even larger design is to be adopted in the new tower.

† These trials were conducted with ordinary messages; not merely code signals. At 5,000 km. messages were received one night, but the next night the ship being now 5,600 km. from Nauen, no signals could be detected.

‡ It is interesting to note the extraordinary development of wireless telegraphy in Morocco. Not only is there an elaborate network of stations installed, but also these are fully engaged. During 1910 the average transmission from Moroccan stations totalled 40,000 words per month, and recently the corresponding figure has exceeded 120,000. This development is the more surprising in view of the absence of built roads, bridges, railways and wire telegraphs.

* It should be remembered that this article was written before the recent Radio Conference.

† The *Zeitschrift fur Schwachstromtechnik* (1911, p. 302) reports wireless communication between San Francisco and the Japanese coastal station of Tschosi Schimosa—a distance of over 10,000 km.—by retransmission from two steamers of the Pacific Mail Co. acting as intermediate stations. The longest of the sections traversed by a single transmission was 6,000 km.

concerned, necessitates a much larger number of coast stations for effective *inter*-communication. Shipowners as a class are conservative, and though there is increasing development in the number of ship equipments voluntarily installed, it is probable that Governmental decrees will soon compel the equipment of all passenger vessels of over a certain size—indeed, action in this direction has already been taken by the U.S.A., Austria, Italy and Argentina.

International data concerning the number of stations in operation in July, 1911, may be summarised as in Table I (to the mercantile ship total of which about 1,000 should already be added). The 163 stations now in use or being installed in the German mercantile marine may be classified by traffic route and class of vessel as in Table II. Forty-six vessels in each of the Hamburg-American and Norddeutscher lines were equipped with wireless apparatus at the date of the returns. In 1911, German mercantile vessels totalled 127,000 messages (counting as one message either a reception or a transmission), *i.e.*, an average of 163 per voyage.

Hitherto, the financial results of wireless telegraph undertakings have not been very striking, owing to the enormous sums expended in experimental work and in developing new types of apparatus. Nor can high dividends be expected till the best systems of working have established their superiority and themselves attained a certain

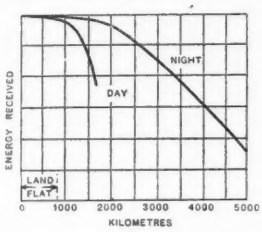
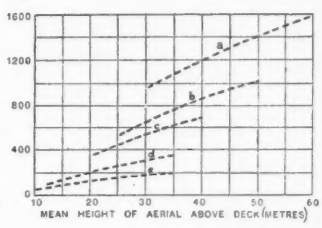


Fig. 5.



a, Large warships; *b*, Medium warships or largest merchant vessels; *c*, Large merchant ships; *d*, Medium merchant vessels or small warships; *e*, Small merchant ships.

Fig. 6.

degree of standardisation of technics. Until then and until the present uncertainties of wireless work have been eliminated, full benefit cannot be derived from the low capital cost of a wireless station, as compared with a cable route, and whatever may ultimately be the case, wireless telegraphy now acts as a supplement and as a reserve to existing cable routes rather than as a fierce competitor.

Types of Station.—To meet various classes of service over distances ranging from 55-500 km., or more, numerous types of station have been evolved and may be grouped as follows:—

1. Land stations radiating from ½ to 100 KW. from the antennæ.
2. Ship stations radiating from $\frac{1}{10}$ to 5 KW. from the antennæ and requiring more or less skill in operation, according to the class of user concerned.
3. Military stations for transport by men or mules.
4. Light stations for use on motor-cars, balloons, air ships and aeroplanes, &c.

Confining our attention mainly to ship stations, and in particular to those suitable for use on merchant vessels, it may at once be stated that the chief distinction between war and merchant vessel equipments is that the latter are as simple and as cheap as possible, and work at one or two international wave lengths, whereas in war vessels cheapness and simplicity are quite secondary to wide range, large reserve power, possibility of close electrical and acoustical tuning and rapid circuit changes to suit transmission and reception over a wide range of wave length.

A number of illustrations in the original article deal with special types of ship station—viz., (1) a 5-km. station operated by accumulators and a trembler coil, and suitable for tugs, aeroplanes, and so on. The accumulators weigh 5 kg., and the remainder of the equipment about 1 kg. more. (2) The largest type of sender yet adopted for merchant ships (see *b*, fig. 6), absorbing 5 to 6 KW. in the primary, and radiating 2·5 KW. (as against 1½ KW. radiated by the average mercantile sets. In a special type of this equipment the space occupied is reduced to a minimum, and vulcanite is substituted for wood, thus making the whole more suitable for use in the Tropics. (3) The main parts of a sender designed for use on small war vessels occupy only 60 × 60 cm. A special variometer allows continuous variation of the wave length up to 200, 300 m., or even higher values, and the aerial power amounts to 1 KW. (4) For large war vessels (see *a*, fig. 6) 5 KW. aerial radiation is provided. Five Leyden jars, each of 10,000-cm. capacity, provide the necessary capacity. By the manipulation of only two levers the circuits can be adjusted in a few seconds to any wave length over a wide range.

Six KW. is about the absolute limit of power radiation possible from ship antennæ, unless the latter are such as to impede the navigation of the vessel. With 5 KW. aerial radiation, the vessels *Eleonore Woermann* and *Lucie Woermann* have effected intercommunication over 3,700 km. across the mountainous part of West Africa (coast to coast), and several other notable performances of Telefunken ship sets are shown in Table III. The average day range of stations on vessels of the German mercantile marine is about 300 km.; fig. 6 shows the usual day range (over clear sea), of various types of ship sets, as a function of the aerial height. Such stations can, of course, *receive* messages from land stations at a much greater distance, and the night ranges for every class of work are two or three times the corresponding day values. Table IV shows some of the more striking results secured by the steamer *Kleist* during her first voyage equipped with wireless apparatus; *every night*, from Bremerhaven to the Red Sea, the vessel could exchange messages with some big land station, and such intercommunication was often possible by day as well. In these trials the *Kleist* worked at full aerial radiation throughout (1½ KW.), but, in ordinary practice, only such radiation is employed as is necessary to establish satisfactory communication; interference with other traffic is thus reduced to a minimum.

(To be continued.)

THE ELECTRICAL MARKET IN SOUTH AMERICA.

A very favourable opinion of the prospects of the countries in South America as a growing market for electrical manufactures is entertained by Mr. Ludwig W. Schmidt, who states (*Elektrotechnische Zeitschrift*, September 26th and October 4th) that one of the most conspicuous characteristics of the economic development in that part of the world in the past 10 years has been the increasing use of electrical energy for lighting and power purposes. On the one hand, coal is either of rare occurrence, or no large deposits of real importance have been discovered, while, on the other hand, the rivers both on the east and the west represent considerable sources of power which are in process of utilisation. Most of the Governments in South America have begun to convert the use of the rivers for power purposes into State monopolies, Chile being the latest example of the kind. In some cases the States have sanctioned the establishment of generating stations in connection with the rivers, but in others the State is the founder. The effect for industry remains the same. The State takes care that the abstraction of water does not unnecessarily weaken the river, and also that the prices charged by the central station are reasonable. Both the States and the cities are large consumers of power, which they partly produce themselves, and partly obtain from existing works. At present South America is only at the beginning of railway construction on a large scale. In some cases trials have been made with electric railways, but steam locomotives have hitherto had to perform the greater portion of the work. The large lighting, telegraph and telephone installations are, above all, of importance to the electrical industry in connection with the activity in railway construction, which will still be continued for a long time, as only a small portion of the continent is now provided with railways.

The newest cities make a direct change from the most primitive methods of lighting to electrical illumination without first having recourse to gas, whilst many towns almost come into existence with electric lighting, seeing that as soon as a town is large enough to possess its own system, electricity is generally adopted at once. This fact is best illustrated by the large number of public contracts which are advertised in the official newspapers every year. An excellent example of the development of electricity for lighting and power purposes exists at Buenos Ayres, of which details have already appeared in this journal in relation to the activity there of the German Transmarine Electricity Co. The conditions are similar in Rio de Janeiro, San Paulo, Monte Video, Lima and Valparaiso. It is naturally impossible to generalise in connection with a market of the extent of that in South America. Orders do not flow uniformly from all quarters. Economic relations which are beyond the control of industries play a part in the shaping of the market, and their influence must show itself in a different way in different places. South America is not as yet an industrial continent in the real meaning of the word, and industries, although rapidly developing, are limited to certain districts in the large towns, and to those places which are specially suitable for carrying them on, as, for instance, the estuary of the River Plate. The continent is preponderatingly an agricultural country, with plantation cultivation in the North. The breeding of cattle has created a large consumer of electricity in the form of the preparation and refrigeration of meat, whilst the mining industry, which is distributed over the whole continent, will also become a good customer when the railways show the way to economic progress by the opening up of new districts. Simultaneously with the development of the production of power, and the provision of new possibilities for utilising it, there is proceeding an expansion in the imports of auxiliary materials, the production of which for the greater part has to be left to European manufacturers. Germany, Great Britain and the United States participate fairly uniformly in the market, although the last-mentioned country has made great progress in recent years.

The author, in proceeding to give a comparison of the respective positions occupied by Great Britain, Germany and the United States in the trade of South America, points out that the statistics published by the countries on the latter continent are very incomplete, and that he has, therefore, been compelled to rely upon those published by the three exporting nations in question, notwithstanding differences in classification, whilst the information has been supplemented, where actual statistics are not available, from the experience of merchants domiciled in the country and by the reports of the Consulates. It is, therefore, expressly stated that the figures must not be accepted as absolutely certain. In all cases the most important classes of goods have been selected for comparison, and although the figures consequently afford no correct idea of the imports in general, they yet permit of a contrast of the influence exercised by the three countries in the most important goods. The four Republics of Brazil, Argentina, Uruguay and Paraguay, which are

the best customers of the electrical industry, first receive consideration. In 1910 the imports of machinery into Sao Paulo, Brazil, for electric lighting purposes amounted to the value of 2,861,000 milreis, as compared with 1,585,000 milreis in 1909 and 842,000 milreis in 1906. The share of the United States in the trade was 1,504,000 milreis in 1910, as contrasted with 913,000 milreis in 1909; that of Germany was 1,024,000 milreis and 462,000 milreis; and that of Great Britain was 225,000 milreis and 146,000 milreis in the two years respectively. The exports from Germany to Brazil have considerably increased in recent years, and have in many cases more than doubled, as, for instance, in regard to dynamos and glow lamps. British exports have not been so fortunate, and although an advance has taken place in the past few years, it cannot be compared with that of Germany or the United States. The position of United States trade in Brazil in 1911 is particularly surprising, as the former exported to the latter almost as much as the combined exports of the other two countries concerned. This predominance is repeated in Peru, Columbia and Venezuela, whilst, at the same time, a powerful advance of the United States electrical industry in South America in general is noticeable. The accompanying table indicates the value of the exports of the three countries to Brazil in the years mentioned:—

TABLE I.—Exports to Brazil.

Germany.	**1908.**	**1910.**
Porcelain insulators	£4,100	£9,100
Dynamos	20,400	52,650
Armatures, &c.	2,600	5,800
Storage batteries, &c.	2,100	3,900
Cables	22,600	46,850
Arc lamps	2,300	1,550
Arc lamp covers	250	100
Search lights	50	1,100
Glow lamps	17,000	50,950
Telegraphs and telephones	39,800	34,550
Materials for lighting and transmission of power	18,000	35,450
Measuring apparatus	2,150	5,100
Heating and cooking apparatus	100	150
Insulating tubes, &c.	200	600
Various	50	—
Total	£131,700	£247,800

United States.	**1907.**	**1911.**
Electrical apparatus, telegraphs and telephones	£165,250	£442,450
Machinery	144,250	96,800
Total	£309,500	£539,250

Great Britain.	**1907.**	**1911.**
Electrical materials of all kinds	£10,900	£2,800
Telephone and telegraph wires	52,900	96,500
Telephone and telegraph materials	22,600	46,100
Electric lamps	1,750	5,950
Storage atteries and cells	550	21,750
Machinery	58,400	90,700
Various	17,600	13,300
Total	£164,700	£277,100

The causes of the great advance made by United States electrical firms in South America are to be found in a number of circumstances which, in the opinion of Mr. Schmidt, will doubtless play a great part in the business development of the market in the future. For some time past the manufacturers in the United States have been making great endeavours to obtain a market in South America. The question is more than that of providing a new outlet for exports; it is one affecting the future of the United States industries. Canada has hitherto been a favourable channel for the latter, but the Dominion is now beginning to establish its own industries, and has no longer any room for the surplus of the United States, although the fact does not at present prevent an increase in the imports from that country. The industries in the United States suffer from frequent collapses in the home market. Sudden and unforeseen stagnation takes place, and business, which a few weeks previously was probably in the midst of a period of high prosperity, exhibits all at once indications of an economic crisis. In order to escape from the unfavourable consequences of such crises, the United States manufacturers need the safety valve of an export trade, which they had found in Canada. But Canadian and European competition in the Dominion has rendered business in Canada much more difficult than formerly, and United States firms therefore wish to assure themselves of a new market outside Canada, this being afforded by South America.

The principle having once been recognised, the manufacturers in the United States set to work with their characteristic energy in order to conquer the South American market, and the electrical firms have not remained in the background in this respect. Excellent commercial reports were the first result; then the Consuls themselves became the commercial agents of United States industries by seeking to procure orders, in which direction they have been surprisingly successful. In some countries where the Consuls were specially assisted by their representation or the circumstances, they have doubled the turnover. Simultaneously with this industrial activity is the Pan-American movement headed by the United States, which aims at a combination of the interests of the South American Republics and the establishment of closer relations between them under the leadership of the United States. It scarcely needs special emphasis that manufacturers and financiers in the United States have also availed themselves of this phase of the development of their relations. In any case this has done much to strengthen the United States in the South American market. A further factor in the situation is that the preference enjoyed in Brazil, Venezuela, &c., may be attributed to a large extent to the possibility of more rapid delivery from the United States, whose manufacturers are able to undertake delivery in a fortnight, including time for correspondence, as compared with six weeks in the case of European firms, in the event of the goods being ready for shipment.

Although admitting the activity of United States propaganda in South America, Mr. Schmidt considers that it would be a mistake to speak of an American (U.S.) danger in regard to that market as affecting the German electrical industry. Taking the respective statistics of the three countries in question, the author states that the value of the most important electrical goods exported from Germany to Brazil, Argentina, Uruguay, Paraguay, Columbia, Peru, Chile, Bolivia, and Venezuela, amounted to £1,262,500 in 1910, and that an increase of £150,000 took place in the three years ended with 1910. On the other hand, the exports of the United States to the same countries reached £775,000 in 1911, and they have advanced by one-third since 1907. If the value of the aggregate electrical imports into South America is estimated at from £3,000,000 to £3,250,000, the share of Germany is two-fifths, and that of the United States only one-fourth. The details in respect of Argentina are set forth as follows:—

TABLE II.—Exports to Argentina.

Germany.	**1908.**	**1910.**
Porcelain insulators	£4,800	£4,000
Dynamos	76,950	82,250
Armatures, &c.	11,100	15,050
Accumulators, &c.	15,100	270,950
Cables	232,950	18,300
Arc lamps	10,800	600
Arc lamp covers	1,050	10,100
Searchlights	700	145,950
Glow lamps	30,500	27,300
Telegraphs and telephones	19,450	112,100
Materials for lighting and transmission of power	85,400	36,550
Measuring apparatus	18,300	3,900
Galvanic cells	800	900
Cooking and heating appliances	250	550
Insulating tubes, &c.	350	700
Various	100	100
Total	£508,600	£729,300

United States.	**1907.**	**1911**
Electrical apparatus, telephones and telegraphs	£52,500	£72,050
Electrical machinery	30,900	37,350
Total	£83,400	£109,400

Great Britain.	**1907.**	**1911.**
Electrical goods of all kinds	£15,100	£9,300
Specially enumerated goods	11,300	29,250
Cables	25,300	39,500
Telephone and telegraph wires	39,900	26,500
Electrodes	1,400	1,700
Electric lamps	3,850	11,200
Searchlights	4,700	4,100
Carbons	250	1,100
Batteries	9,050	30,450
Unenumerated	47,000	45,000
Machinery	60,650	160,100
Total	£218,500	£358,200

The author proceeds to give details in regard to the exports to other countries in South America. In the case of Uruguay, Germany exported electrical goods of the value of £102,300 in 1908, and increased the total to £130,150 in 1910; the United States were responsible for £4,650 in 1907 and £7,600 in 1911, whilst the statistics attributed to Great Britain represent £2,050 in 1907 and £650 in 1911. The figures for Paraguay, Bolivia and Venezuela, of which no record is given for Great Britain, are almost too insignificant to mention, beyond the fact that the German exports to Bolivia in 1910 reached £5,000, as against £1,000 in 1908, and those of the United States to Venezuela amounted to £20,600 in 1910, as compared with £34,800 in 1907. In the case of Columbia, the German exports increased from £1,400 in 1908 to £3,350 in 1910, and those from the United States from £9,590 in 1907 to £18,300 in 1911, but Great Britain does not publish any separate figures for this country. The Chilean market absorbed electrical goods from Germany of the value of £349,200 in 1908, as contrasted with £166,000 in 1910; £44,300 from the United States in 1907 as against £53,900 in 1911; and £66,200 and £55,300 from Great Britain in the two years respectively. The German exports to Peru in 1908 amounted to £11,200, as compared with £11,300 in 1910, but those from the United States declined from £60,400 in 1907 to £22,300 in 1911, and those from Great Britain from £40,700 in 1907 to £564 in 1911.

The opening of the Panama Canal next year is also discussed by Mr. Schmidt, who, far from thinking that the canal will strengthen

foreign competition in the South American market, considers that the improvement in the means of transport by the reduction in the journey to the west coast will place European manufacturers in a more favourable relation to United States rivalry. After referring to the orders resulting to United States and British firms from the financial participation in the construction of railways in South America, the working of mining concessions, &c., the author remarks that German financiers have hitherto only taken a limited share in the industrial development of that continent, and that the German electrical industry will consequently have to rely upon its own resources in South America. This has already been done with great success, and most of the large electrical companies are interested in the South American business either by having direct agents or by selling through other establishments of a similar kind. In conclusion, it is submitted that business will develop enormously in the next few years, and that South America will become one of the most important markets with which the German electrical industry will have to reckon.

REVIEWS.

How to Manage the Dynamo. By A. R. Bottone. London: Whittaker & Co. Price 9d.

This book is claimed to be specially suitable for "thoroughly good engineers who . . . . . find themselves suddenly called upon to undertake the management of a dynamo." In the preface the author promises to make no attempt at explaining theoretical details; unfortunately, he has broken this promise to the extent of making some misleading statements concerning the excitation of various dynamos.

The introductory paragraphs do not read very smoothly, and it would certainly be better to say that electromotive force is induced in the armature winding than that the armature winding "generates a current." On page 11 we find the extraordinary statement that the output of a separately excited machine is independent of any variations which may take place in the outer circuit. The action of a shunt-wound dynamo, as outlined on page 13, is also very misleading; for instance, we are told that the insertion of a large external resistance compels a larger quantity of current to pass round the field-magnet coils, and this sets up higher E.M.F. to overcome the excessive resistance. The following is worth quoting in full:—"In the series dynamo, as we have seen, if a very low resistance be placed in the outer circuit, so large a current is produced and carried through the coils surrounding the field magnets and armature that the insulation is nearly sure to be burnt up; while in the case of the shunt dynamo, the lower the resistance in the outer circuit the less current passes round the field-magnet coils; and even if the outer resistance be greatly increased, the very great resistance of the field-magnet coils themselves prevents any very great amount of current passing through them, so that the shunt dynamo is much less subject to injury from sudden variation in the outer circuit than the series dynamo. Still, it is not well to allow a shunt dynamo to run for any considerable length of time with nothing or a very high resistance in the outer circuit, since, under these circumstances, the field-magnet coils would slowly but surely heat up, hence by the use of a regulating resistance inserted in the field circuit, the magnetising current can be regulated, with consequent variation in the output of the dynamo to a limited extent." There are various ways of regarding different electrical problems, but this explanation does not commend itself to us. The explanation of the action of a compound field winding is also totally incorrect. Technical inexactitudes of a less or equal importance are too frequently recurrent to be mentioned in detail. A popular hand-book need not be technically inaccurate, and the use of technically loose or inaccurate terms merely increases the difficulties met by the student when he endeavours to pass from a popular to a more advanced treatment of his subject.

On page 21 we note that "the practical engineer will understand at once that when in place the armature must ride free from the pole pieces and not bump or knock at any part"—we hope so. On page 28, it is recommended that incandescent lamps be not switched off till the dynamo has so far slackened speed that the lamps no longer glow. "This conduces greatly to their long life."

The notes on localising and remedying defects in the dynamo are better than the introductory sections, but frequently suffer from the author's very unfortunate (if no worse) method of considering the field action of dynamos. The engineer who tries to measure the actual output of a dynamo "by means of a voltmeter or ammeter directly across the terminals of the dynamo" (page 43) is likely to receive a surprise.

Figs. 10 and 11 represent positive accumulator plates by a short thick line, which is certainly contrary to general convention. In one of these diagrams, a battery is shown regulated from the positive end, while in the other, the regulating cells are at the negative end; in the text it is stated that the battery should always be regulated from the positive end. The best practice is, of course, to regulate from the negative end. On the whole, the definitions of technical terms (pages 54-64), are good, but the definition of a short circuit as:—"A short passage, opened either accidentally or intentionally, along which the current can pass instead of going along the main circuit, as usual"—might certainly be much improved. On the whole, we fear that the book is likely to lead to many theoretical and practical misapprehensions in the minds of those who read it.—R. E. N.

Electricity. By Gisbert Kapp. London: Home University Library. Williams & Norgate. Price 1s. net.

There has always existed among scientific men a strong feeling against "Popular Science," and even the appearance of such men as Faraday and Tyndall as popular lecturers failed to change the general attitude. But the scientists' dictum that to know a little is a dangerous thing has been opposed by the man in the street on the ground that half a loaf is better than no bread; and so strong has been his claim to satisfy his hunger for scientific knowledge, that he has generally contrived to carry off his half loaf in triumph. And so we have popularised editions of most of the standard scientific works, and popular lectures and pamphlets on every branch of science.

The whole case against the popular science book is based on the difficulty of reducing science to popular language without creating false impressions and conveying inaccurate information. While admitting the difficulty, there is no necessity to magnify it into an unsurmountable obstacle, and there is no obvious reason why the exercise of care and judgment should not succeed in avoiding error and ambiguity of statement, and, at the same time, produce a highly informative and interesting book on pure or applied science.

In this Prof. Kapp has succeeded to a degree. He has used a mathematical method of statement in some cases—a fact that will, perhaps, frighten away a few of the least hungry seekers after knowledge—and he has perhaps written over the heads of his readers in places, but we have not noticed any errors or obscurities, and there can be no doubt that the book is eminently interesting and readable. There are nine chapters, the last two being neat essays on alternating currents and power distribution. The order of treatment in some of the chapters appears to be unusual, but this is probably a result of the writer's popular style. The book may be recommended as a good shillingsworth to the man who wants to gain accurate ideas about electricity with the expenditure of a minimum amount of mental energy.—P. H. S. K.

The Motor-Generator: In Theory and in Practice. By J. W. Barber. London: Ganes, Ltd. Price 1s. net.

This excellent little volume has been specially written for use by cinematograph operators; it clearly explains the reasons for and the advantages of, the use of motor-generator plant, and deals with the troubles likely to be experienced with the latter. Chapters I and II define and explain the various electrical units involved, and the author is to be complimented on the clearness and technical accuracy of his expression. The fundamental laws and phenomena of magnetism are explained in Chapter III, and the next chapter deals with the principle and construction of electromagnets. The material in these two chapters is excellent, but, in our opinion, it would have been better to have

devoted less space to these chapters with a view to explaining the principles of generators (Chapter V) in rather more detail. The latter chapter is excellent so far as it goes, but we anticipate that many operators will have some little trouble in following this section. Types of generators and the broad principles of their construction are dealt with in Chapter VI. Unfortunately, fig. 19 has been printed upside down. Chapters VII and VIII deal with the electromechanical principles of the electric motor, its back E.M.F. and starting action, the evolution of motor-starters and the essential components of various types. Chapter VIII explains the economy effected by the use of motor-generators, as compared with a simple resistance in series with the arc, and illustrates this economy by actual examples. The supply conditions and classes of load for which motor-generators are economical are clearly explained; the limitations generally placed by supply companies on the size of motors connected to lighting mains and the possibility and advantages, in special cases, of running from power mains are clearly noted.

Chapter X deals with the management of motor-generators, and should prove extremely useful to operators. Chief importance is, very properly, attached to the care of the commutator, and we are glad to note that the author deprecates the use of recessed micas; "high" micas are certainly avoided by the latter method of construction, but the accumulation of foreign matter in the commutator grooves is rapid and dangerous. The notes on lubrication (Chapter XI) maintain the practical excellence of the rest of the volume, the whole of which is to be thoroughly recommended. The value of the book is greatly increased by the numerous illustrations, a few of which might, however, be drawn more neatly in later editions; it is a pity to detract from the otherwise excellent appearance of the volume by so easily remedied a defect. Operators would doubtless appreciate a section comparing, from a practical standpoint, the various types of motor-generators now available.—R. E. N.

Electrical Cooking and Heating in Canada.—At a time when so much attention is being bestowed on the development of electrical cooking and heating in this country, it is worth noticing what our Canadian friends are doing towards the same end. Quite recently, according to the *Canadian Electrical News*, the Ottawa Electric Co. replaced a standard gas stove by an electric kitchen range of the same capacity, in a house where gas had previously been used exclusively for cooking, and averaged 5,500 cb. ft. per month. The gas stove was taken out altogether, in order to ensure fair-play, and a 30-days' test undertaken. It is reported that the electric range cooked satisfactorily, except that it was found to be slower while heat regulation was not so easy. Both these difficulties were apparently due to lack of experience. A recording meter showed a breakfast load of 3—4 KW.; for the noon meal, 4—5·5 KW.; and for the evening meal, 3·5—4·5 KW.; the maximum load was 5·5 KW. Meter readings showed that 295 units were consumed, and the respective figures for gas and electricity, at $1.25 per 1,000, and 3 c. per unit respectively, with 10 per cent. discount in each case, were, for the month, $6·19 gas and $7·97 electricity. So far as mere direct cost is concerned, electricity at 2·1 c. per unit would represent equal cost, but this takes no account of the cleanliness, convenience and other advantages possible with the electric cooker. It is important to note that the above test was made by a company which controls both the gas and electric services, and therefore has no reason to favour either system. It is considered that with more experience the difference of cost would disappear.

Copper.—Messrs. Merton's statistical circular for September 30th shows that, at the end of that month, European visible supplies stood at 47,945 tons, a decrease of 2,387 from the quantity registered for August 31st. English stocks remain within 1 ton of the quantity for August 1st, the reduction being in German, Dutch and French stocks, and in the quantities afloat from Chile and Australia. In the supplies columns, we find that N. American contributions are still rather low, Spain and Portugal the same, while Chilean and Australian shipments are just under the average. The deliveries for the month are decidedly low, at 35,539 tons. The world's visible supply at the end of August was 71,181 tons, the American stocks being 20,849. This not the lowest this year, the latter being 19,793 at the end of June, but gives the impression that the U.S. demand is getting very close to supply.

Street Accidents.—Replying to a Parliamentary question asked by Mr. Kellamey of the Home Secretary, Mr. McKenna states that he is informed by the Commissioner of Police that 118 people were killed by motor-omnibuses and 21 by electric tramways in the metropolitan area from January 1st to October 8th.

COST AND CONDITIONS OF LIVING IN SOUTH AFRICA.

By A RESIDENT.

The conditions of living in Natal are, as may be supposed, somewhat different from those obtaining in the Old Country. To begin with, the climate, generally speaking, is excellent, the temperature varying from about 115° F. in the shade in the hottest coastal places in summer, at which time it is exceptionally hot, to when white frosts are on the ground in the early hours of the winter mornings; these are, however, soon dispelled by about 8 a.m. or 9 a.m. by the sun, and a lovelier climate at this time of the year cannot be imagined, the weather being bright and dry. During the summer, clouds gather, culminating in sharp and severe thunderstorms of short duration, accompanied by very heavy rains, about 5 p.m. or 6 p.m., or during the night.

The seasons are opposite to those in England, summer rains starting about August. These are usually preceded by hot winds, accompanied by dust storms, then after a short spell of fine weather, the summer sets in, and it breaks up towards the end of March, when cold rains set in, lasting from three to six or more days at a stretch.

The cost of living is, at present, somewhat over a third more than at home, though one has to pay more than this proportion for luxuries and entertainments generally. A bachelor should not undertake to come to Natal under about £200 per annum if he wishes to live comfortably. Board and lodging can be obtained in a good establishment from £5 10s. to £6 10s. per month, not including washing, the latter costing about 10s. per month, or even more. A married man cannot do much on less than £250 per annum, and I should say that £300 a year is little enough. What it costs a bachelor for board and lodging it almost costs a married man for house rent alone, before anything else is thought of. Hotel fares are from 10s. to 15s. per day.

In Pietermaritzburg a good cottage with five rooms, kitchen, pantry, boys' and out-houses, &c., also back and front verandah, with garden, can be obtained in a nice locality for from £4 10s. to £5 10s. per month, but there are also much cheaper houses, from £2 upwards in less desirable localities, among coloured people. In Durban rents are slightly higher. These prices are what obtain at present.

One requires, if married, at least one servant. This may be either an Indian coolie or a kaffir, the latter an Umfaan (young boy), from 10s. per month upwards. I pay my boy now £1 per month: he can do almost everything, including cooking and setting the table for meals, &c., and is an exception, but it all depends upon how he is trained at the outset, and a little patience without indulgence is rewarded. The language used generally in the towns between Europeans and servants is known as "kitchen kaffir"; it is a mixture of English, Dutch and the native lingo, and though a corruption of each, it suffices. One drawback to the native servants is that the boys soon get homesick and do not often stay longer than six months, so that just when they are getting used to the work a new one has to be taken on and training again begins.

The kaffir boy lives on mealy meal (this is provided by his employers, and costs about 10s. per month) and meat once a week.

The wages and salaries paid in Natal are shown below, and the list will, I think, be found to be approximately correct; the hours are eight per day:—

Skilled telegraph mechanicians ...	per annum	£180-£250
Skilled telegraph linesmen	,,	£170-£220
Cable-jointers, electric light ...	per month	£14 to £20
Stokers, electric light	,,	£13
Switchboard attendants	,,	£16 to £20
*Enginemen	,,	£13 to £14
Cabinet-makers	per day	12s. to 16s.
Carpenters	,,	12s.
Plumbers	,,	12s.
Fitters	,,	12s.
Bricklayers	,,	12s. to 14s.
Clerks, about	per annum	£150 and upwards.

* If he can do own repairs, goes to £19.

The following list of provisions and luxuries may also prove interesting:—

Boer tobacco, per lb.	2s. to 3s. 6d.
Natal cheroots (good), per 100	4s. to 6s. 6d.
Whisky per bottle, average price	6s. 6d.
Natal beer and stout, per quart, dozen	8s.
Draught beer (Natal), per glass	4d.
Cape wines per bottle, from...	9d. to 2s. 6d.
Bread, per 2lb. loaf (at present)	4½d.
Condensed milk, per tin	6d.
Jams, per tin	6d. to 8d.
Fresh milk, per 1½ pint bottle	4d.
Potatoes, per 100 lb., vary from	5s. to 15s.
Bananas at the door, per dozen	3d.
Candles, per packet	6d. to 8d.
Paraffin oil, per case 10 gallons	11s.
Suit of clothes, good, from	£5 5s. upwards.
Boots and shoes, good, from	£1 5s. upwards.
Rail fares per mile : See foot-note.*	
Rickshaw fares in 3d. stages.	
Meat, 7d. to 10d. per lb.	

Owing to the price of furniture, which is generally lighter than that used at home, one is disposed to do more for himself in making things than he would ever think of doing at home; and on account of the trouble of bringing furniture out, I would not recommend people to bring any. There are always plenty of sales going on, when the furniture can be obtained cheaply.

Coal costs (per ton)	£1 6 0
Firewood (per ton)	0 13 6

The former does not burn well, so has to be assisted with firewood. When leaving a house one always takes one's own stove, a custom which, I believe, prevails also in Scotland.

The prices quoted refer to the principal towns only, and for the country transport should be added.

Electric trams run in Durban and Pietermaritzburg, and there is also electric light. Speaking generally, we are not badly off for entertainments, such as concerts, theatres, bioscopes, skating rinks, travelling shows, &c. Sport is largely indulged in, especially cricket and football, and nearly everyone plays tennis.

In the country there is plenty of scope for shooting and fishing, some of the rivers being well stocked with trout. Most people ride, in town and country, bicycles being largely used.

Telephonically speaking, most places are connected, and in Durban and Pietermaritzburg there are telephone exchanges of about 2,000 and 800 subscribers respectively.

Anyone contemplating coming to Natal, should visit his tailor and lay in a fair stock of clothes, similar to those worn at home in summer; also boots and underclothing—the latter should be woollen, and of good quality. As Unions do not hold much sway in this country, a man must be prepared to adapt himself to do work other than that to which he has been confined at home, and, in conclusion, let me say that it is very inadvisable for anyone to come here on the chance of obtaining work at present. The depression, though believed to be lifting, is still felt, and there are many unemployed already in the country.

As regards the cost of living in Johannesburg, it works out at about £11 per month more than in Natal, the chief items making the difference being the higher house rents, *i.e.*, from £10 to £12 per month for a house similar to that mentioned for Natal, and the house boys £3 per month. Water is at the rate of 5s. per 1,000 gallons, and light 6d. per unit. Lodgings with board can be had for from £7 10s. to £10 per month, and washing from 12s. to 18s. per month. The climate is very dry, and it is therefore unwise to bring out furniture, as it cracks badly during the very dry part of the year. The altitude is about 6,000 ft. above sea level, and does not suit everyone, especially those subject to heart weaknesses, and very often insomnia is a great source of distress.

Entertainments are good and cheap, and good artistes are engaged at the music halls and theatres. Johannesburg is a very busy town, and several people find that they have to work harder than they were accustomed to do at home. The suburbs are excellent and well served with trams, the fares being in 1½d. stages, and living out of town one will do well to add from 15s. to £1 extra per month for tram fares. I understand that there are more motor-cars in this town per cent. of the population, than in any other town in the world, and the same remark applies to the number of motor and other bicycles. The wages for really good workmen average about £1 per day, though I fear that as the Transvaal settles down to bed-rock, these prices will not obtain.

So varied are the salaries paid up here that it is difficult to put anything down on paper, but it is safe to say that £300 per annum is not sufficient for a married man to live comfortably on, and I would suggest that no man agree to take a billet, if married, at less than £350 if he is at all comfortably off at home.

There are very many unemployed in Johannesburg. Many of them are good workers who, through retrenchment in various departments on the mines and other employing agencies, have been thrown out, and I cannot imagine a greater hardship than to be out of work in a town such as this.

The population is very largely made up of Jews, and the competition is extremely keen all round, there being much under-cutting of prices.

In winter the climate is very cold and often very windy, raising great dust storms which are decidedly unpleasant, the dust finding its way into every nook, and rendering one's clothes very shabby in a short time.

In conclusion, I would advise no one to sacrifice a certain billet to come out here, otherwise the consequences may be serious: at the same time it is well to add that the place grows on one, and the longer one stays in it the less one is inclined to leave it. The telephone exchange of Johannesburg serves about 6,500 subscribers in town, and there are very many sub-exchanges in the suburbs and on the mines.

*Railway Fares on the South African Railways.

These are on a scale which provides that the further you travel the cheaper it becomes (Europeans do not, as a rule, travel third here). For instance :—

Miles.	Single. 1st class.	Single. 2nd class.	Return. 1st class.	Return. 2nd class.
1 ...	£0 0 3	£0 0 2	£0 0 5	£0 0 3
12 ...	0 2 0	0 1 4	0 3 6	0 2 4
24 ...	0 4 0	0 2 8	0 7 0	0 4 8
50 ...	0 8 4	0 5 7	0 14 7	0 9 9
100 ...	0 16 8	0 11 1	1 9 2	0 19 5
200 ...	1 13 4	1 2 3	2 18 4	1 18 11
1,000 ...	6 13 4	4 8 11	11 13 4	7 15 7

For distances exceeding 1,500 miles, first-class single is 1·35d. per mile, second ·90d., and return journeys at 75 per cent. on the single fares.

Industrial Value of French West African Rubbers.—The French Colonial Office furnishes the following information comparing the industrial value of three rubbers grown in French West Africa. The data in the following table refer to specimens of: (1) Smooth brown pancakes from Hevea-brasiliensis; 1909 crop, province of Porto-Novo; coagulation by acetic acid; (2) "Scraps" from Landolphia Heudelotii; 1910 crop in province of Kankan; natural coagulation by liana; (3) "Scraps" Ceara; 1909 crop, province of Sedhiou; coagulation by citron. The samples were treated mechanically, dried and vulcanised to 3, 5 and 10 per cent. of sulphur during three hours at 140° C. Taking fine Para hard-cure as the basis of comparison (unity coefficient in each case), the following results were obtained :—

	Hevea.	*Landolphia.*	*Ceara.*
Flexibility	1·8 %	2·4 %	1·3 %
Nerve	0·65%	0·2 %	0·8 %
Tenacity	0·9 %	0·9 %	1·0 %
Extensibility ...	1·6 %	3·2 %	1·0 %
Elasticity ...	0·8 %	0·6 %	0·6 %

Compared with the Hevea from Ceylon, the Porto-Novo product has less nerve, less elasticity but greater extensibility; it has also less nerve than the Hevea from the Belland and Ong-Yem plantations in Indo-China. The Landolphia rubber is particularly flexible and extensible, but has low nerve and elasticity. Ceara rubber resembles wild Para, but has rather more nerve and less elasticity than the latter.

Electricity in the Oilfield.—According to the *Financial News*, the use of electricity in the oilfields of California is proving to be a great economy. Pumping and drilling by electricity is very much cheaper than any other method. The San Joaquin Light and Power Co. is doing a large business in this line. It is estimated that the average cost per day of pumping a well by steam is $9, while the average cost by electricity is $1·02. The majority of the wells pumped are about 1,500 ft. deep, but some of those handled by this company are 3,000 ft.

The London Chamber of Commerce.—We have received from the Chamber some literature relating to the Chamber of Commerce: "What it is; What it does; and What it offers." Particulars relating to membership, fees, &c., can be obtained on application to the secretary at the offices, Oxford Court, Cannon Street, E.C.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

AUSTRALIA.—The Commonwealth Customs authorities have issued the following decisions as to the duties to be levied on certain electrical goods; the duties quoted are those under the preferential tariff adopted for British goods:—

Machinery, photo-copying, continuous (electrical)	20 per cent. ad val.
Pocket lamps, electrical	10 " "
Battery cells imported with, and for, telephonic wall or table sets	10 " "

NORWAY.—The Norwegian Government have decided to allow the duty free admission of double tube superheaters for steam boilers, if for ships' boilers only.

DENMARK.—The Danish Customs Authorities have issued the following decisions as to the rates of duty to be levied on certain electrical and similar goods imported into Denmark:—

So-called dynamo brushes, consisting of a shaped piece of carbon, 3 cm. × 2 cm., and 9 mm. thick. On one end of the brush the carbon is coated with copper and a metal plate is soldered thereto, a piece of wire (laced copper wire) ending in a single brass contact being fastened to the metal plate	2 öre per kg.
Ignition magnets, which are intended to be attached to benzine motors in order to produce a spark to ignite the benzine when rapidly revolved by hand, and which consist of two large, powerful double magnets, between which is placed a dynamo armature enclosed in a square case consisting mainly of lacquered brass	7½ per cent. ad val.
Arc lamps, consisting of a "cap" of painted or varnished sheet-zinc, in which the machinery proper (metal rods, wire, a few iron rods and various other parts) is fixed, the lower part of this machinery being surrounded by a "case" of black varnished iron plate, less than 1 mm. thick, which is fastened to the cap with iron hooks, and on the lower part of which the globe is also to be fixed by means of iron hooks ...	20 öre per kg.

NOTE.—These lamps are dutiable at this rate even if they are imported in parts, though in the same consignment, provided there is no doubt that the various parts belong together and that the importer desires them to be so classed for duty.

N.B.—100 öre = 1s. 1½d.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

22,185. "Electric hot-air blower." F. REISS. September 30th.

22,197. "Ignition systems for motor-vehicles." A. L. RIKER. (Convention date, September 30th, 1911, United States.) September 30th. (Complete.)

22,269. "Storage and transit of incandescent electric lamps." G. POULTON. September 30th.

22,221. "Ignition devices for internal combustion engines." A. BUTSCH. September 30th.

22,231. "Electric lamp switches." M. J. HOPPOCK, jun., and A. STOUT. September 30th. (Complete.)

22,246. "Vapour electric apparatus." P. C. HEWITT. (Convention date, October 10th, 1911, Germany.) September 30th. (Complete.)

22,251. "Automatic controlling device for electric cut-outs." J. H. DE THIERRY. (Convention date, September 30th, 1911, Italy.) September 30th. (Complete.)

22,252. "Telephone receivers." BRITISH L. M. ERICSSON MANUFACTURING CO., LTD., and A. BROOKES. September 30th. (Complete.)

22,253. "Intercommunication telephone receivers." BRITISH L.M. ERICSSON MANUFACTURING CO., LTD., and A. BROOKES. September 30th. (Complete.)

22,258. "Electrically-heating apparatus of various kinds." E. C. R. MARKS. (Landers, Frary & Clark, United States.) September 30th. (Complete.)

22,262. "Combined electric indicators and steam-flow meters." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) September 30th.

22,270. "Method and apparatus for commutation." C. W. GIRVIN. October 1st. (Complete.)

22,275. "Trolley heads." J. A. WALSHAW. October 1st.

22,280. "Electrolytic decomposition." E. HIGGINS. October 1st.

22,308. "Apparatus for generating electricity." H. K. BOYLE. October 1st.

22,311. "Oscillating spring contact for operating electric bells and such like apparatus." F. BUBE, jun. October 1st.

22,328. "Electrical means for preventing the opening of doors of railway vehicles whilst in motion." G. R. POOLE and E. W. PERRY. October 1st.

22,339. "Indicating or meter mechanisms." G. WALL and FERRANTI, LTD. October 1st.

22,354. "Manufacture of alkali metal alloys by the electrolysis of caustic alkalis in a fused state, and in the manufacture of alkali metals, and derived products therefrom." E. A. ASHCROFT. October 1st.

22,355. "Testing the waterproof covering of electric cables." C. J. BEAVER and E. A. CLAREMONT. October 1st.

22,375. "Electrical resistances." C. E. HAY and H. W. SULLIVAN. October 2nd.

22,381. "Electrical appliance." P. PINCKNEY. October 2nd.

22,387. "Sparking plugs." W. J. CHARLES. October 2nd.

22,412. "Means for electrical alarm signalling in connection with steam engines and machinery." T. H. HILL. October 2nd.

22,418. "Electrical regulators." O. S. SCHAIRER. (Convention date, Otober 5th, 1911, United States.) October 2nd. (Complete.)

22,419. "Electrical regulators." A. A. TIRRILL. (Convention date, October 5th, 1911, United States.) October 2nd. (Complete.)

22,423. "Starting devices for electric motors and like apparatus." G. ELLISON. October 2nd.

22,446. "Means to record sounds electrically, and reproduce same by mechanical or other means." J. L. THOMPSON and A. S. WARNE. October 2nd.

22,450. "Mine exploders." STERLING TELEPHONE AND ELECTRIC CO., LTD. (Schaffler & Co., Austria.) (Addition to 27,318/06.) October 2nd.

22,452. "Therapeutic magnetic machine." J. COLE. October 2nd.

22,470. "Locking device for keeping an electric lamp of any type, or an electric candle locked in socket and quite upright." VERITYS, LTD., and F. W. THORPE. October 3rd.

22,477. "Switches of the tumbler kind." W. J. CHARLES. October 3rd.

22,491. "Electric heating apparatus." F. B. COX. October 3rd.

22,494. "Mechanical and electrical railway fog-signalling apparatus." T. GIBSON, G. A. FARMER and E. READ. October 3rd. (Complete.)

22,499. "Control of electric circuits." P. A. G. RAPPIS. October 3rd.

22,500. "Dynamos." J. POLKEY and G. POLKEY, LTD. October 3rd.

22,505. "Diaphragm suitable for gramaphones, phonographs, telephones, and other acoustic machines and instruments." C. ELLIS and G. FOX. October 3rd.

22,509. "Time lag devices for electric switches and other apparatus." M. J. RAILING, J. STRACHAN and H. J. COATES. October 3rd.

22,520. "Variable speed dynamo-electric machines arranged in the charging circuit of accumulators." J. PEUGEOT. October 3rd. (Complete.)

22,521. "Electrical current generating machines with reverse compounding." J. PEUGEOT. October 3rd. (Complete.)

22,524. "Prevention of sparking in the control of electric circuits." W. A. PRICE. October 3rd.

22,530. "Sparking plugs." E. H. DELIGNY. (Convention date, October 5th, 1911, France.) October 3rd. (Complete.)

22,534. "Covering electric conductors with plastic material." W. S. SMITH and A. D. SHUTER. (Addition to 16,542, 1911.) October 3rd. (Complete.)

22,539. "Switch indicators." H. H. BERRY. October 3rd.

22,542. "Conversion of electric energy." W. A. PRICE. October 3rd.

22,548. "Manufacture of metal filaments." POP'S ELECTRIC LAMP CO., LTD. (C. Trenzen, Germany.) October 3rd.

22,549. "Means for suspending arc lamps." G. SCHANZENBACH & CO. G.M.B.H. (Convention date, May 21st, 1912, Germany.) October 3rd. (Complete.)

22,555. "Telephone fittings." SIR B. LEIGHTON. October 3rd.

22,561. "Electric furnaces." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) October 3rd.

22,568. "Circles for magnetic compasses, surveying and levelling instruments." J. C. FERGUSSON. October 4th.

22,589. "Arc lamps." R. H. BURKITT. (Addition to 4,417, 1912.) October 4th.

22,591. "Circuit connection for electrical installations with mixed loads." LANDIS & GYR. (Convention date, October 12th, 1911, Switzerland.) October 4th. (Complete.)

22,592. "Tariff electricity meter." LANDIS & GYR. (Convention date, October 6th, 1911, Switzerland. Addition to 1,010, 1912.) October 4th. Complete.)

22,600. "High-tension electrical ignition devices for internal-combustion engines of the multi-cylinder type." L. A. HINDLEY, H. D. HINDLEY and W. STANFORD. October 4th.

22,603. "Electrical egg tester." H. B. GARNHAM and A. E. GARNHAM. October 4th.

22,604. "Electrically controlled clocks." W. H. BURGESS. (Divided application on 23,558, 1911, October 25th. October 4th. (Complete.)

22,646. "Means for controlling electrically operated mechanisms and the like." H. H. R. GREEN. October 4th.

22,649. "Electric signals." A. C. BROWN. October 4th.

22,664. "Electric motor-control systems." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) October 4th.

22,691. "Magnetic advertising machine." R. W. SUFFLING, P. GREIG and J. HARRISON. October 5th.

22,696. "Trolley pulleys of electric tramcars and the like." E. WARREN, J. WARREN, F. WARREN, E. WARREN, jun., and A. WARREN. October 5th.

22,728. "Electric conductors or resistances and apparatus in which the same are employed." H. G. DICKER and S. A. LOVICK. October 5th.

22,729. "Electrical instrument for use in lighting and other power circuits." J. E. OWENS and H. A. PUTTOCK. October 5th.

22,788. "Safety electric lamps more especially intended for use in mines." W. H. HANSON, H. L. LANGSTON and ELECTRICAL POWER STORAGE CO., LTD. October 5th.

22,747. "Controlling devices for electric motors." A. H. CURTIS, A. H. MACKLEY and ADAMS MANUFACTURING CO., LTD. October 5th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & CO., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

RELAYS FOR STRENGTHENING WEAK ELECTRIC CURRENTS. J. Schiessler. 20,320. September 13th.

MOTOR FEED MECHANISMS FOR ELECTRIC ARC LAMPS AND FURNACES. H. J. Booker. 20,738. September 19th.

WORKING OF TELEGRAPH AND TELEPHONE CIRCUITS AND THE LIKE. E. S. Heurtley. 20,787. September 20th.

SPEED REGULATION OF ELECTRICALLY-DRIVEN RING SPINNING AND TWISTING FRAMES. Siemens Bros. Dynamo Works, Ltd., and J. F. Crowley. 20,919. September 21st.

ARTIFICIAL LINES USED IN DUPLEX TELEGRAPHY. S. G. Brown. 21,000. September 22nd.

ELECTRICAL PLUG AND SOCKET CONNECTIONS. A. F. Berry. 21,054. September 23rd.

COMPENSATING DEVICE FOR TELEPHONIC CIRCUITS. S. G. Brown. 21,069. September 23rd.

CORD WEIGHTS OF TELEPHONE SWITCHBOARDS OR THE LIKE. Siemens Bros. and Co. and E. A. Laidlaw. 21,165. September 25th.

MECHANISM FOR CONTROLLING VALVES, SWITCHES OR THE LIKE AT PREDETERMINED TIMES. E. J. Morrison. 21,489. September 28th.